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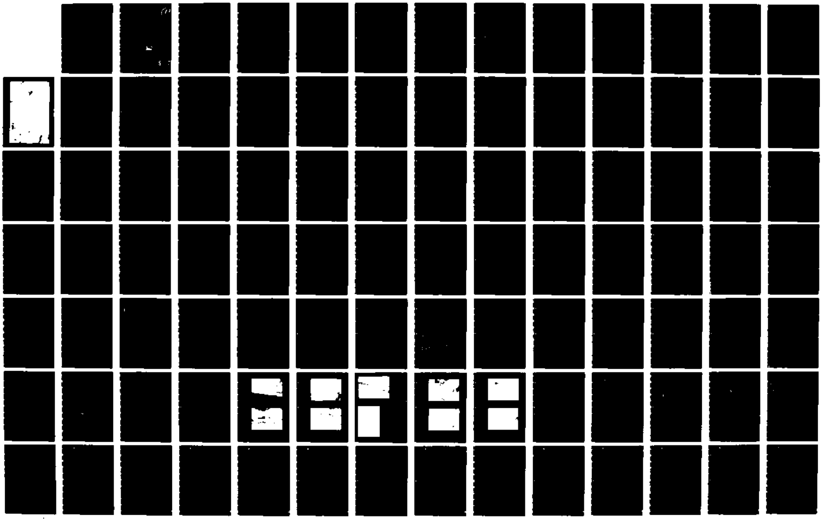

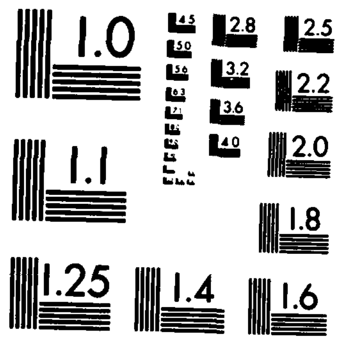

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CONNECTICUT COASTAL BASIN

RIDGEFIELD, CONNECTICUT

LAKE NARANEKA DAM
CT 00223

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

AUGUST 1981

LAKE NARANEKA DAM

CT 00223

CONNECTICUT COASTAL BASIN

RIDGEFIELD, CONNECTICUT

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Ridgefield, Conn.

Lake Naraneka Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Lake Naraneka Dam is a 156-foot-long and 18 ft. high concrete gravity dam which is arched in plan. The spillway is incorporated into the left side of the dam. The visual inspection of the dam indicated that the structure is in fair condition. Since the dam is within the Corps' criteria for the small size category for storage (50 to 1,000 ac-ft), the dam is considered to be SMALL in size. The test flood will be between one-half the PMF.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION. CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM. MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

SEP 21 1981

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Lake Naraneka Dam (CT-00223) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Environmental Protection, and to the owner, Twixt Hills Home Owner's Assoc., Ridgefield, CT. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Protection for your cooperation in this program.

Sincerely,

C. E. Edgar III

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.: CT 00223

Name of Dam: Lake Naraneka Dam

Town: Ridgefield

County and State: Fairfield, Connecticut

Stream: Kiahas Brook

Dates of Inspection: June 30 and July 14, 1981

BRIEF ASSESSMENT

The Lake Naraneka Dam, constructed in 1937 for recreational purposes, is a 156-foot-long and 18-foot-high concrete gravity dam which is arched in plan. The owner of the dam is Twixt Hills Home Owner's Association. The dam is 4 feet wide at the crest; has a 0.1H:1V sloped upstream face; and a downstream face which is inclined at approximately 0.65 H:1V. The spillway is incorporated into the left side of the dam. The 11-foot-long spillway, located about 30 feet from the left abutment, discharges into a 60-foot-long stone paved channel. Discharge from the site may also pass through the manually controlled 14-inch diameter low level outlet or the 2-inch and 8-inch diameter conduits that supply and drain the small masonry pool at the downstream toe of the dam.

The visual inspection of the dam indicated that the structure is in fair condition. Seepage and wet areas were observed on the downstream face of the dam. Extensive efflorescence, cracking, and spalling of the concrete was noted at many areas on the top, upstream, and downstream faces of the dam.

The Lake Naraneka Dam has a top of dam storage capacity of 675 acre-feet (ac-ft) and is approximately 18 feet in height. Since the dam is within the Corps' criteria for the small size category for storage (50 to 1,000 ac-ft), the dam is considered to be SMALL in size. The failure of the dam could potentially cause the loss of more than a few lives; therefore, the dam has been classified as having a HIGH hazard potential.

In accordance with the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", the size classification (SMALL), and the hazard classifiction (HIGH) of the dam, the test flood will be between one-half the Probable Maximum Flood (1/2 PMF) and the Probable Maximum Flood (PMF). Since the storage capacity for the dam is within the upper limits of the small size category the larger test flood was selected. Therefore, the test flood for the Lake Naraneka is the Probable Maximum Flood. As a result, the peak inflow to the reservoir would be 2,350 cubic feet per second per square mile (cfs/sq.mi.) or 1,080 cubic feet per second (cfs) for the drainage area of 0.46 square miles and the peak outflow is 500 cfs. The capacity of the spillway, with the water surface at the top of the dam, is 215 cfs or 43 percent of the routed test flood outflow. As a result, the dam will be overtopped by 0.7 feet.

It is recommended that the owner retain the services of a qualified registered professional engineer to perform the following services: investigate the areas where seepage has occurred, determine the effect of seepage on the stability of the dam, and take steps to insure that seepage does not deteriorate the structure; develop a program to restore the deteriorated concrete on the dam; supervise the removal of trees and root systems and backfilling the resulting voids; provide the means to maintain a dry valve chamber; assess the condition of the low level outlet works; monitor the repair of the spillway discharge channel; and access the need to provide the means for emergency closure on the upstream end of the low level outlet.

The recommendations and remedial measures outlined above and discussed in Section 7 should be instituted within one (1) year of the owner's receipt of this report.

Reynold A. Hokenson

Reynold A. Hokenson, P.E.
Project Manager
International Engineering Company, Inc.

COMMONWEALTH OF MASSACHUSETTS
REYNOLD A. HOKENSON
No. 23125
REGISTERED PROFESSIONAL ENGINEER

This Phase I Inspection Report on Lake Naraneka Dam (CT-00223) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

JWFinegan

JOSEPH W. FINEGAN, JR. MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechmical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm

event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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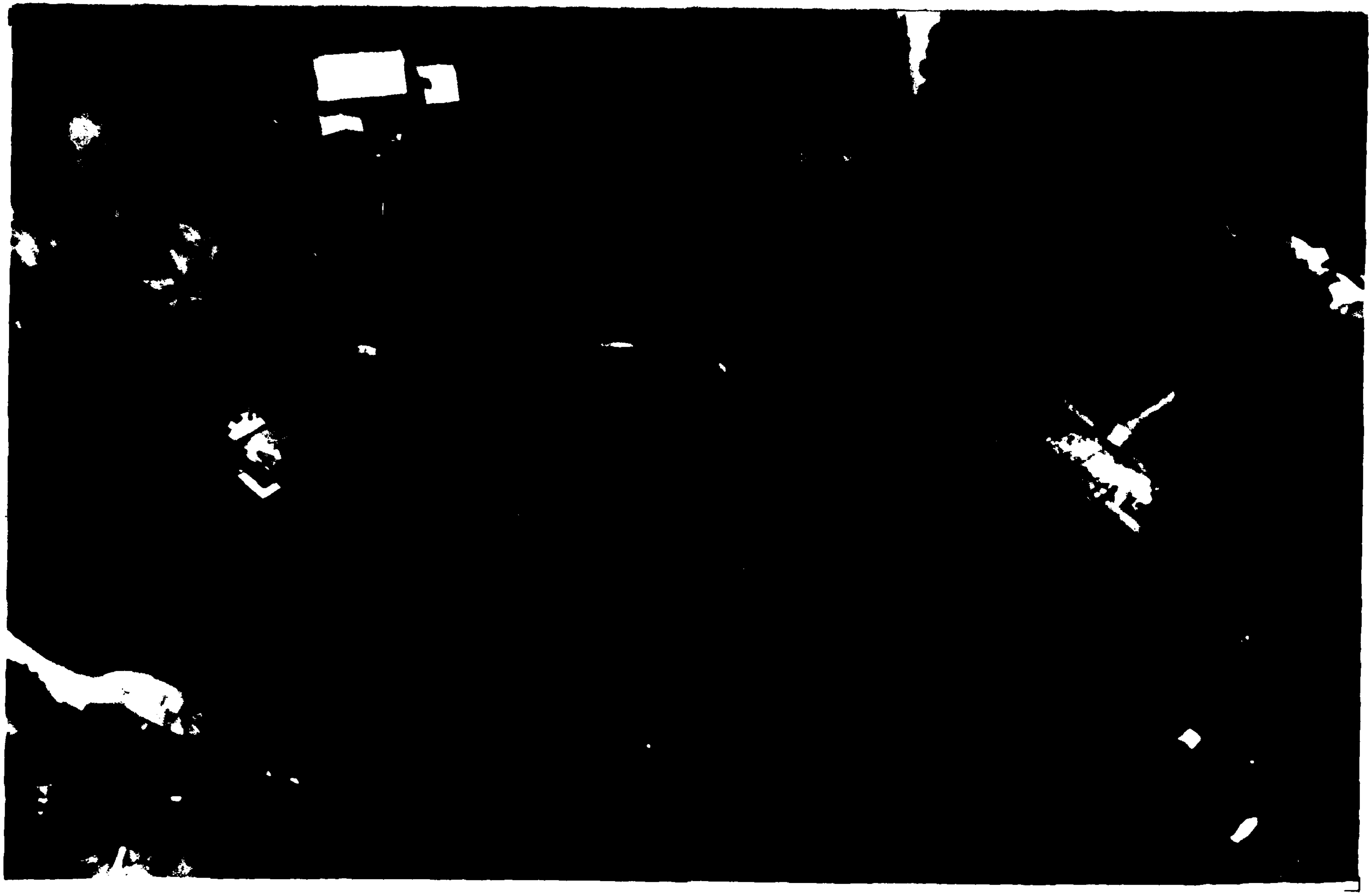
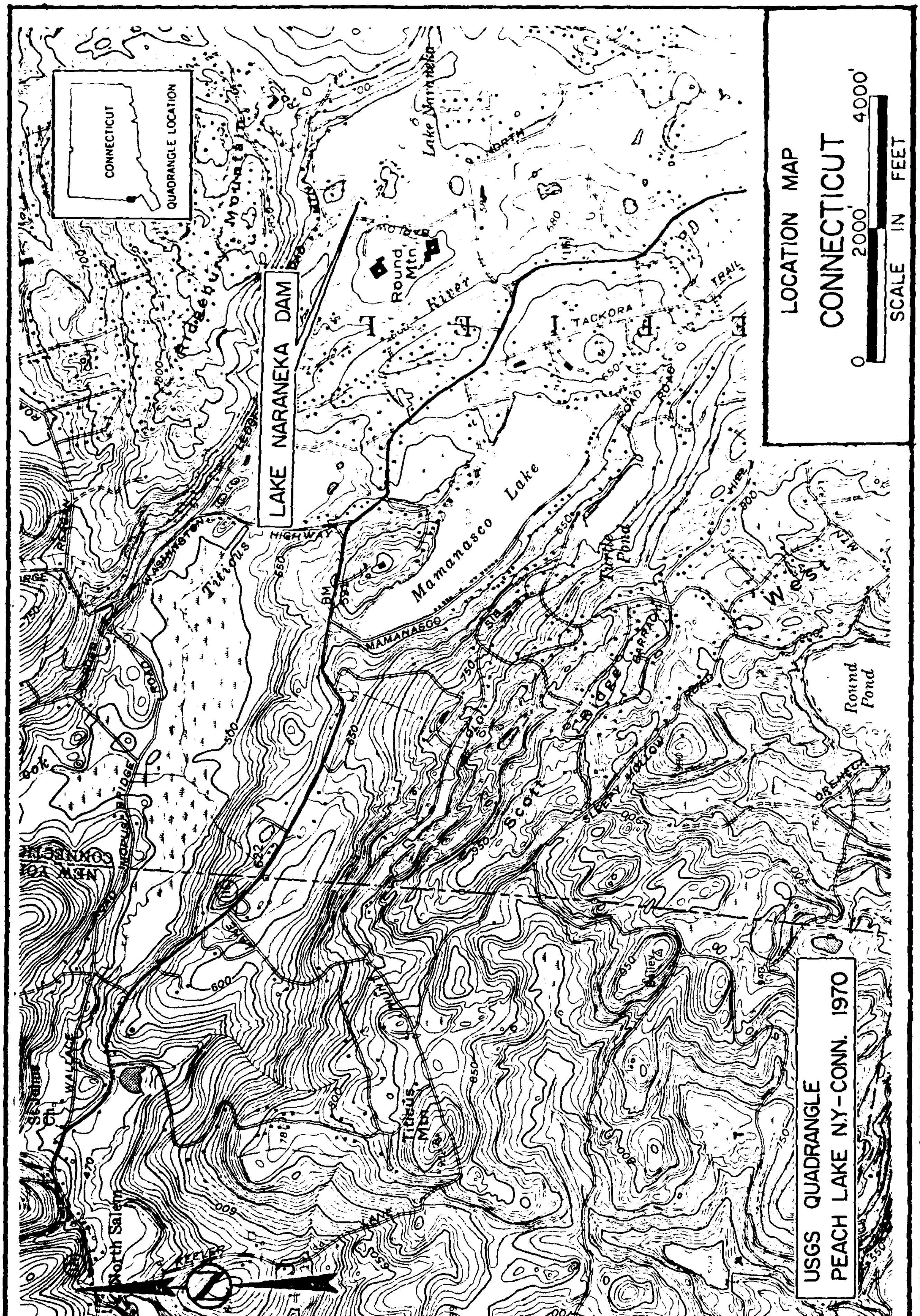


OVERVIEW PHOTO–LAKE NARANEKA DAM

AUGUST 1981


LAKE NARANEKA DAM
CONNECTICUT
QUADRANGLE LOCATION
LOCATION MAP
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SCALE IN FEET
USGS QUADRANGLE
PEACH LAKE NY-CONN. 1970

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

LAKE NARANEKA DAM

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority — Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England region. International Engineering Company, Inc., has been retained by the Corps' New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to International Engineering Company in a letter dated June 18, 1981, from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-81-C-0015 has been designated by the Corps for this work.

b. Purpose of Inspection Program — The purposes of the program are to:

(1) Perform technical inspections and evaluations of non-Federal dams to identify conditions requiring correction in a timely manner by non-Federal interests.

(2) Encourage and prepare the States to quickly initiate effective dam inspection programs for non-Federal dams.

(3) Update, verify, and complete the National Inventory of Dams.

c. Scope of Inspection Program — The scope of this Phase I Inspection Report includes:

(1) Gathering, reviewing, and presenting all available data as can be obtained from the owners, previous owners, the state, and other associated parties.

(2) A field inspection of the facility detailing the visual condition of the dam, embankments, and appurtenant structures.

(3) Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

(4) An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgement on the safety or stability of the dam other than on a visual basis. The purpose of the inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 DESCRIPTION OF PROJECT

a. Location — The dam is located on Kiahas Brook in the Town of Ridgefield, Fairfield County, Connecticut, approximately one-half mile upstream from the confluence with Titicus River which flows into the Titicus Reservoir. The location of the dam is defined by the coordinates latitude N41°19.5' and longitude W73°30.6' on the Peach Lake, New York-Connecticut, USGS Quadrangle Map.

b. Description of Dam and Appurtenances — The facility consists of a 156-foot-long, 18-foot-high concrete gravity dam, a 12-foot-long broad crested spillway incorporated into the left side of the dam, and low level outlet works to drain the reservoir.

The dam is arched in plan and is 4 feet wide at the top (El. 587.3 NGVD; Note: All elevations are referenced to the National Geodetic Vertical Datum). The upstream face of the dam is sloped at 0.1 H:1V and the downstream slope has an inclination of 0.65H:1V.

The spillway consists of two 5.5-foot-long by 3.5-foot-high openings divided by a 1-foot-wide concrete pier. Each spillway opening has 3-inch slots for installing stoplogs. Discharge over the 4-foot-wide spillway crest (El. 583.8) passes into a 60-foot-long, by 12-foot-wide stone paved channel. The channel is bordered by 1.5-foot-high rubble masonry training walls on each side.

The 14-inch diameter low level outlet pipe and a 2-inch diameter cast iron pipe pass through the dam approximately 60 feet and 64 feet from the right abutment, respectively. Regulation of flow through these conduits is provided by the hand-operated valves that are housed in a 7-foot by 8.5-foot concrete valve chamber located immediately downstream from the dam. Access to the valves is through a 2-foot diameter manhole on the roof of the chamber. Adjacent to the downstream wall of the valve chamber is a small pool, formed by mortared masonry walls. The 14-inch outlet (Invert El. 569.6) passes beneath this masonry structure and terminates at the downstream wall of the small pool. The 2-inch diameter pipe (Invert Elevation unknown) was designed to supply the pool with water. An 8-inch diameter conduit in the downstream wall of the pool is used as a drain (Invert El. 471.2). Flow from the 8-inch drain is regulated by a hand operated valve located at the end of the pipe.

c. Size Classification - SMALL - The size classification is based on the height of the dam above the natural streambed or the maximum storage of the reservoir, which is defined by a pool at the level of the dam crest. The size classification of the dam is determined by the criteria that yields the larger size category. Lake Naraneka Dam has a maximum potential storage capacity of 675 ac-ft, which is within the established limits for the small size category (50 ac-ft to 1,000 ac-ft), and the height of the dam (18 feet) which is below the limits for the small size category (25 feet to 40 feet). Thus, the dam is considered to be SMALL in size.

d. Hazard Classfication — HIGH — The hazard classification is based on the estimated loss of life and the anticipated property damage due to a dam breach when the water surface within the impoundment is at the crest of the dam. The prefailure outflow from Lake Naraneka Dam would flood the first downstream home to a depth of approximate 0.3 feet and the second downstream home would experience 4 feet of flooding. The failure of the dam would flood the first downstream home to a depth of 4.9 feet, the second downstream home to a depth of 7.4 feet and a third home would experience 2 feet of flooding. Consequently, the flood would damage three homes along Ledges Road, damage the roads and road culverts at Barlow Mountain Road and Kiahas Brook Lane, and could potentially cause the loss of more than a few lives. Therefore, the Lake Naraneka Dam had been classified as having HIGH hazard potential.

e. Ownership _ Twixt Hills Home Onwer's Association
Susan M. Bankes, President
114 Seth Low Mountain Road
Ridgefield, Connecticut 06877
(203) 438-4105

f. Operator _ Twixt Hills Home Owner's Association
Charles E. Bordenkircher
Ecology Chairman
(203) 438-6043

g. Purpose _ Lake Naraneka is used for recreational purposes only.

h. Design and Construction History — The dam was designed by Mr. Samuel B. Hoyt, C.E., of Norwalk, Connecticut, and constructed in 1937 to create a recreational reservoir. The construction was peformed by Bacchiochi, Inc. No substantial changes in the project have been made since the original construction of the dam.

i. Normal Operational Procedures — The water level in the reservoir during the summer is normally maintained at the top of the 0.5-foot-high stoplogs (El. 584.3). Lowering of the pond is performed during the Fall using the 14-inch diameter outlet conduit. The exact pool level maintained after lowering of the lake in the Fall is unknown.

1.3 PERTINENT DATA

a. Drainage Area _ The drainage area consists of 0.46 square miles (sq. mi.) of hilly and wooded terrain.

b. Discharge at the Dam Site _ Discharges at the dam site normally occur over the spillway crest, but may also pass through the 14-inch diameter outlet conduit.

(1) When the water surface is at the top of the dam, the 14-inch outlet conduit (invert elevation 569.6) will pass 21 cfs.

(2) The maximum known flood at the dam site could not be determined, since there are no flow or gage records maintained for Kiahas Brook.

(3) Ungated capacity of the spillway is 215 cfs at elevation 587.3.

(4) Ungated spillway capacity at test flood elevation (588.0) is 280 cfs.

(5) Gated spillway capacity at normal pool elevation _ N/A.

(6) Gated spillway capacity at test flood elevation _ N/A.

(7) Total spillway capacity at test flood (elevation 588.0) is 280 cfs.

(8) Total project discharge at top of dam (elevation 587.3) is 235 cfs.

(9) Total project discharge at test flood (elevation 588.0) is 300 cfs.

c. Elevations (feet above NGVD)

(1)	Streambed at toe of dam		569.6
(2)	Bottom of cutoff		565.8
(3)	Maximum tailwater		Unknown
(4)	Normal pool	Summer	584.3
		Winter	Unknown
(5)	Flood-control pool		N/A

(6)	Spillway crest	583.8
	Top of Stoplogs	584.3
(7)	Design surcharge (original design)	Unknown
(8)	Top of dam	587.3
(9)	Test flood surcharge	588.0

d. Reservoir (length in feet)

(1)	Normal pool	1,800
(2)	Flood-control pool	N/A
(3)	Spillway crest pool	1,800
	Top of Stoplogs	1,850
(4)	Top of dam	2,000
(5)	Test flood pool	2,000

e. Storage (acre-feet)

(1)	Normal pool	490
(2)	Flood-control pool	N/A
(3)	Spillway crest pool	490
	Top of Stoplogs	490
(4)	Top of dam	675
(5)	Test flood pool	680

f. Reservoir Surface (acres)

(1)	Normal pool	55
(2)	Flood-control pool	N/A
(3)	Spillway crest pool	55
	Top of Stoplogs	56
(4)	Top of dam	60
(5)	Test flood pool	60

g. Dam

(1)	Type	Concrete gravity
(2)	Length	156 ft
(3)	Height	18 ft
(4)	Top width	4 ft
(5)	Side slope	Upstream 0.1H:1V and 0.65H:1V downstream
(6)	Zoning	N/A
(7)	Impervious core	N/A
(8)	Cutoff	3-foot-deep key founded in ledge
(9)	Grout curtains	None

h. Diversion Canal	N/A
i. Spillway	
(1) Type	Concrete broad crested weir
(2) Length of weir	11 ft
(3) Crest elevation	583.8
Top of Stoplogs	584.3
(4) Gates	Stoplogs
(5) U/S channel	Lake Naraneka
(6) D/S channel	Stone paved discharge channel and Kiahas Brook
j. Regulating Outlets — Outlet conduits	
(1) Invert elevations: 2-inch outlet	Unknown
14-inch outlet	569.6
8-inch outlet	571.2
(2) Size	2-inch diameter; 18-inch diameter valve servicing 14-inch diameter outlet; and 8-inch diameter
(3) Description	Cast iron
(4) Control mechanisms	Hand-operated
(5) Other	Only the 14-inch conduit is used to lower the pond

SECTION 2: ENGINEERING DATA

2.1 DESIGN DATA

A set of design drawings and an as-built drawing by Samuel B. Hoyt, C.E., of Norwalk, Connecticut were available.

2.2 CONSTRUCTION DATA

The Lake Naraneka Dam was constructed in 1937 by Bacchiochi, Inc. A number of slides from photographs made during the dam construction were provided by the owner.

2.3 OPERATION DATA

There are no provisions for monitoring the reservoir level or the condition of the dam. According to the representative of the Twixt Hills Home Owner's Association, the 14-inch outlet conduit is normally operated during September to lower the pond before the winter to control weed growth along the borders of the lake. The amount of water discharged during this period is not measured or recorded.

2.4 EVALUATION OF DATA

a. Availability — Data was provided by the owner (Twixt Hills Home Owner's Association) and the State of Connecticut Water Resources Department. In addition, representatives from the Twixt Hills Home Owner's Association were at the dam site during the inspection to discuss the history of the dam and operation of the outlet works.

b. Adequacy — The available data was supplemented by field survey measurements performed by International Engineering Company engineers. The available data was not sufficient to perform an in-depth stability analysis of the dam. The final assessment of the dam, therefore, was based on the visual inspection, performance history, and hydraulic computations of spillway capacity.

c. Validity — The field inspection indicated that the visible external features of the Lake Naraneka Dam agree with those shown on the as-built drawing. However, the shape of the foundation key varied between the as-built and design drawings.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General – The field inspections of the Lake Naraneka Dam were conducted on June 30 and July 14, 1981. At the time of the first inspection, the water surface elevation was approximately 584.3 and the stoplogs were in place.

b. Dam – The dam is an arched in plan concrete gravity structure (Photo 1). Deterioration of the concrete was noted on the exposed surfaces of the dam. At three locations on the downstream face, approximately 30 feet from the right abutment, 80 feet from the left abutment, and at the construction joint adjacent to the valve chamber (90 feet from the left abutment), the deteriorated concrete was damp and efflorescence was noted (Photo 6). This seepage is apparently passing through poor joints and cracks in the concrete. Seepage in the vicinity of the construction joint has flooded the valve chamber (Photos 9 and 10). In addition, two marshy areas were found adjacent to the deteriorated concrete on the downstream face. One marshy area is located 30 feet from the right abutment and extends approximately 20 feet along the downstream face and projects 15 feet from the dam. The second marshy area is 70 feet from the left abutment and is approximately 15 feet square.

Weathered, cracked, and spalling concrete was also noted on the top and upstream face of the dam over almost the entire length of the structure. The most severe deterioration appears to have occured on the right side of the dam (Photo 5). It should be noted that this dam was constructed without vertical expansion joints. Only one vertical construction joint was noted.

The spillway, located on the left side of the dam, has two openings divided by a concrete pier and a stone paved discharge channel with low rubble masonry training walls (Photos 1, 2, and 3). Deterioration of concrete was noted on the top of the pier and

abutments. The stoplogs installed in the spillway slots were sound and only minor leaks were observed (2-4 gpm). A horizontal pipe on the upstream side of the spillway was anchored to the dam approximately 1.5 feet above the top of the stoplogs (Photo 1 and 2). The exact purpose of this pipe is unknown, however, it is speculated that it prevents small boats from being washed over the spillway crest when the spillway is operational. The timber platform spanning the spillway was in good condition. The stone pavement in the spillway discharge channel was generally intact and no severe displacement of the stone masonry was observed. However, the root systems of large trees located along this channel have caused slight bulges in the masonry floor (Photo 3). In addition, the stone masonry joints have expanded, thus allowing water to flow beneath the discharge channel floor. Seepage totalling approximately 2 to 4 gpm was noted at the end of the discharge channel (Photo 4).

c. Appurtenant Structures - There are two potential regulating outlets to drain the reservoir (Photo 7). The 14-inch low level cast iron conduit is used primarily to drain the impoundment. The 2-inch outlet, which was designed to fill the small masonry pool at the toe of the dam, and the 8-inch pool drain are no longer used. Presently, the masonry pool is filled with debris and is overgrown with vegetation. The concrete chamber which houses the control mechanisms for the 14-inch and 2-inch diameter outlet conduits is in good condition. No cracks or spalling was observed in this structure (Photo 8.) However, the interior of the structure is filled with water to within 4 feet of the roof. In addition, it appears that the 18-inch valve for the 14-inch pipe leaks; since a small, undeterminable amount of discharge was observed at the end of the pipe. Currently, the outlet valves are all reportedly operational.

d. Reservoir Area — The area immediately surrounding the reservoir is largely residential and wooded. The banks of the reservoir appeared to be stable.

e. Downstream Channel — The downstream channel originates at the spillway discharge channel and follows the natural path of Kiahas Brook

to the Titicus River. The banks of the channel are, for the most part, rocky and wooded. Kiahas Brook passes through a 3-foot-wide by 1.7-foot-high corregated metal pipe beneath Barlow Mountain Road approximately 320 feet from the dam. Approximately 2,000 feet downstream of Lake Naraneka Dam is a small concrete dam which creates a pond. Immediately downstream of this dam is a second pond which is formed by fill in the channel. A home is located at the right bank at each of the ponds (total two homes); and a third home is located on the left bank, adjacent to the second downstream pond. Further downstream, the brook passes through a 4-foot diameter concrete culvert beneath Kiahas Brook Lane about 0.45 miles from the dam.

3.2 EVALUATION

Based on the visual inspection of Lake Naraneka Dam, it has been determined that the structure is in generally fair condition. The following features, which could influence the condition and/or stability of the dam in the future, were identified:

(1) Seepage through the dam could reduce the ultimate load capacity of the structure by deteriorating the concrete and eventually reducing the depth of section.

(2) The marshy areas at the downstream toe may be indications of seepage along the foundation.

(3) Leakage from the 14-inch conduit may be an indication of worn valve seals or the intrusion of water from within the valve chamber into the conduit. Either possibility would adversely effect the operation of the outlet.

(4) The trees growing at the abutments and downstream toe of the dam could damage the structure in the event they were uprooted. This would also add to the amount of debris in

the discharge channel. In addition, the penetration of the root systems from these trees could promote seepage along the foundation.

(5) Trees growing along the spillway discharge channel could reduce the spillway capacity in the event they were uprooted by damaging the channel itself and adding to the amount of debris in the channel. In addition, the penetration of the root systems beneath the masonry floor will continue to displace the masonry and promote seepage beneath the channel. This seepage could ultimately displace the stone masonry and obstruct the channel and thus reduce the discharge capacity.

(6) The flooding in the valve chamber could adversely effect the operability of the valves by inducing the corrosion of the mechanisms.

(7) The existing valves are the only means available to stop flow through the outlet conduits. In the event the repair of the valves is required, there is no means of stopping flow at the intake so that the conduit may be dewatered. Therefore, additional outlet control should be provided.

(8) The horizontal bar across the spillway could retain debris during periods of high flow and thus reduce the capacity of the spillway.

(9) During periods of high spillway discharge, the rubble masonry walls bordering the spillway discharge channel may be overtopped. Flows not contained within this channel may scour the downstream toe of the dam and eventually undermine the structure.

SECTION 4: OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

a. General – Lake Naraneka is used for recreational purposes only. As a result, flow normally passes over the concrete spillway and through the 14-inch low level outlet conduit.

b. Description of Any Warning System in Effect – There is no formal downstream emergency warning system in effect at the site.

4.2 MAINTENANCE PROCEDURES

a. General – Currently, no regularly scheduled maintenance is performed at the dam. However, the dam is normally checked periodically by the owner's representatives, and problem areas are noted. Repairs are performed upon approval by the Twixt Hills Home Owner's Association. At the time of the inspection there were no indications of any recent maintenance; however, those repairs that had been made in the past were pointed out during the inspection. These repairs include: resurfacing concrete in the vicinity of the spillway, removal of a diving board at the midsection of the dam, and the construction of a wooden platform above the spillway.

b. Operating Facilities – According to representatives from the owner, the 14-inch low level outlet conduit is used to lower the pond during September to control weed growth along the banks of the lake. The 2-inch and 8-inch diameter outlet conduits are no longer used.

The stoplogs are used to increase the size of the recreational pool. However, regulation of the impoundment is normally performed with the low level outlet conduit.

4.3 EVALUATION

The maintenance procedures currently employed at the site are inadequate. Records documenting the operation and maintenance of the facility and providing a detailed account of the work and/or operations performed should be kept for future reference. In addition, a formal downstream warning system, emergency operating guidelines, and a program of annual technical inspection by a qualified registered professional engineer should be established. Remedial measures and maintenance recommendations are presented in Section 7.

SECTION 5: EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

The watershed is 0.46 sq. mi. and is comprised of mountainous - rolling and wooded terrain. The dam is a concrete gravity structure arched in plan, with a concrete spillway which discharges into a stone paved channel.

The dam and appurtenant structures are in fair condition. The concrete surfaces of the dam are cracked and extensive spalling has occurred. Deterioration of the concrete on the downstream face of the dam is accompanied by local dampness. Marshy areas were also found along the downstream toe of the structure and may indicate seepage along the foundation. Numerous mature trees and saplings were also observed growing at the toe and abutments of the dam and along the masonry spillway discharge channel. Penetration of the root system beneath the spillway discharge channel has caused some localized bulging of the channel floor.

The valve chamber appeared to be structurally sound, but was flooded to within 4 feet of the chamber roof. The outlet valves are reportedly operational and the 14-inch conduit is currently used to draw down the lake. A small immeasurable amount of leakage was noted at the outlet of the 14-inch conduit; however, it was impossible to determine if this leakage originates from the valve chamber or the valve.

5.2 DESIGN DATA

No design data pertaining to the hydrologic or hydraulic features of the dam were available.

5.3 EXPERIENCE DATA

No information concerning serious problem situations arising at the dam were found.

5.4 TEST FLOOD ANALYSIS

The maximum potential storage capacity of Lake Naraneka Dam (675 ac-ft) is within the upper limits of the small size category established by the Corps in the "Recommended Guidelines for Safety Inspection of Dams", dated September, 1979. The hazard classification for the dam is HIGH, since there is the potential for the loss of more than a few lives due to the breach of the dam. Based on the storage capacity, height, and hazard, the recommended test flood for this dam is between one-half the Probable Maximum Flood (1/2 PMF) and the Probable Maximum Flood (PMF). Since the size classification (SMALL) approaches the upper limits of the classification criteria, based on the storage capacity, the test flood is the Probable Maximum Flood (PMF). The peak inflow due to the test flood in a 0.46 sq. mi. mountainous-rolling watershed is 2,350 cfs/sq. mi. or 1,080 cfs. The inflow due to the test flood (1,080 cfs) and outflow (500 cfs) will cause the water surface elevation to rise to El. 588.0 or 0.7 feet above the top of the dam. The capacity of the spillway is 215 cfs with the water surface at the top of the dam (El. 587.3) or 43 percent of the routed test flood outflow. The spillway capacity is reduced by approximately 20 percent when the stoplogs are in place. As a result, when the 0.5 foot-high stoplogs are in position the spillway will pass approximately 170 cfs or 34 percent of the routed test flood outflow. This reduction would cause the dam to be overtopped by an additional 0.1 feet during the test flood.

5.5 DAM FAILURE ANALYSIS

Utilizing the "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", dated April, 1978, the failure outflow due to

the water surface within the impoundment at the top of the dam was calculated to be 5,080 cfs. The resulting breach width (97 feet) did not include the spillway section and, therefore, the spillway discharge at the time of failure was included in the failure outflow.

The failure of Lake Naraneka Dam will cause the water surface within Kiahas Brook in the vicinity of the first downstream home (1,900 feet from Lake Naraneka Dam) to rise from 2.3 feet above the top of dam (El 546) impounding the pond adjacent to this home, at a prefailure outflow of 215 cfs, to 6.9 feet after the failure. As a result, the first downstream home would be flooded to a depth of at least 4.9 feet and would experience 0.3 feet of flooding prior to the dam breach. A second home located approximately 2,100 feet downstream of Lake Naraneka Dam and adjacent to a second small pond will experience 4 feet of flooding prior to the breach and about 7.4 feet of flooding after the failure occurs. The first floor elevation of this home is about 4.7 feet (El. 543) above the water surface elevation of the pond shown on the flood plain map in Appendix D. The third home within the impact area, located on the left bank of the second downstream pond and approximately 10 feet above pond level (first floor El. 548), will experience 2 feet of flooding after the failure of Lake Naraneka Dam; no prefailure flooding is anticipated. Consequently, the dam breach would damage 3 homes and the bridge culverts at Barlow Mountain Road and Kiahas Brook Lane and could potentially cause the loss of more than a few lives. Therefore, the hazard classification of Lake Naraneka Dam is HIGH.

SECTION 6: EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATION

The inspection did not reveal any indications of immediate stability problems. However, deterioration of the concrete and evidence of leaching accompanied by seepage in the deteriorated areas was noted. Seepage was also observed at the end of the spillway discharge channel and evidence of seepage was found at two locations along the downstream toe of the dam and at the valve chamber. The seepage emanating from the spillway channel masonry was clear and contained no suspended particles. The clarity of seepage at other areas could not be determined. Extensive cracking and spalling of the concrete on the top and upstream faces of the dam were noted.

At the present time, the conditions observed at the site appear to have been occuring over an extended period of time and are not considered to be immediate stability concerns.

6.2 DESIGN AND CONSTRUCTION DATA

Design drawings and an as-built drawing by Samuel W. Hoyt, Jr., Company, Inc. of South Norwalk, Connecticut, dated May 1937 and January 1938, respectively, were available. However, the features depicted on the design and as-built drawings do not correspond. As a result, the exact configuration of the foundation and submerged portions of the dam could not be confirmed with the available drawings. Those features of the dam that were accessible, however, were best represented on the as-built drawing dated January, 1938.

6.3 POST-CONSTRUCTION CHANGES

There were no records nor indications from the owner defining any post-construction changes of the dam.

6.4 SEISMIC STABILITY

The dam is in Seismic Zone 1 and according to the Recommended Guidelines, need not be evaluated for seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition - Based upon the visual inspection of the site, the dam is in fair condition. No evidence of structural instability was observed in either the dam, the spillway, or the outlet structure. However, severe deterioration of the surface concrete was observed on the top, and the upstream and downstream faces of the dam. In addition, seepage was noted at the downstream toe of the structure.

Based on the "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", dated April, 1978, peak inflow to the reservoir is 1,080 cfs; peak outflow is 500 cfs with the dam overtopped by 0.7 feet. The hydraulic computations yield a spillway capacity of 215 cfs with the water surface at the top of the dam, which is equivalent to approximately 43 percent of the routed test flood outflow.

b. Adequacy of Information - The information available is such that an assessment of the condition and stability of the dam must be based on the visual inspection, past performance of the dam, and sound engineering judgement.

c. Urgency - It is recommended that measures presented in Sections 7.2 and 7.3 be implemented within one (1) year of the owner's receipt of this report.

7.2 RECOMMENDATIONS

It is recommended that the following items be undertaken by a registered professional engineer qualified in dam design and inspection:

(1) Investigate those areas where seepage was noted and determine the effect of seepage on the stability of the

dam. Steps should then be taken to insure that seepage does not deteriorate the structure and become a problem in the future.

(2) Investigate and evaluate the condition of the deteriorated concrete on the top, and upstream and downstream faces of the dam. A program for the repair of the concrete should be developed.

(3) Perform a detailed hydrologic-hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase project discharge capacity.

(4) Remove trees and root systems within 20 feet of the downstream toe of the dam, dam abutments, and the masonry spillway discharge channel. The resulting voids should be backfilled with a suitable compacted material and protective growth established to prevent future erosion.

(5) Provide a means to dewater the valve chamber and prevent future accumulation of water in the structure.

(6) Assess the condition of the low level outlet intake structure, conduit, and valve. Institute a program for the renovation of these items if warranted.

(7) Repair those areas on the floor of the spillway discharge channel that have heaved and where mortar is missing from the masonry joints.

(8) Provide a means of emergency closure at the intake of the low level outlet conduit.

(9) The height of the rubble masonry walls bordering the spillway discharge channel should be increased.

The owner should implement the recommendations of the Engineer.

7.3 REMEDIAL MEASURES

a. Operation and Maintenance Procedures – The following measures should be undertaken within one (1) year of the owner's receipt of this report and continued on a regular basis.

(1) A formal program of operation and maintenance procedures should be instituted and documented to provide accurate records for future reference.

(2) An "Emergency Action Plan" should be developed that includes: monitoring the project during periods of intense rainfall; a downstream warning system; locations of emergency equipment, materials, and manpower; and authorities to contact.

(3) Institute a program of an annual technical inspection by a qualified registered professional engineer.

(4) The horizontal bar across the spillway should be removed.

7.4 ALTERNATIVES

This study has identified no practical alternatives to the above recommendations.

APPENDIX A

VISUAL CHECK LIST WITH COMMENTS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT: Lake Naraneka Dam

DATE: 6/30 & 7/14/81

TIME: 12:00 NOON

WEATHER: Sunny, 80° F

W.S. ELEV. 584.3

PARTY:	INITIALS:
1. Reynold A. Hokenson	RAH
2. Miron B. Petrovsky	MBP
3. Ernst H. Buggisch	EHB
4. Jerry R. Waugh	JRW

PROJECT FEATURE:	INSPECTED BY:
1. Dam	RAH, MBP
2. Low level outlets	MBP, EHB, RAH
3. Spillway	RAH, EHB, JRW

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam DATE 6/30 & 7/14/81

PROJECT FEATURE: DAM NAME RAH, MBP

AREA EVALUATED	CONDITION
CONCRETE DAM	
Crest Elevation	587.3
Current Pool Elevation	584.3
Maximum Impoundment to Date	Unknown
Surface Cracks	Many cracks on top and slopes
Pavement Condition	N/A
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Heavy concrete deterioration
Indications of Movement of Structural Items on Slopes	None
Trepassing on Slopes	N/A
Sloughing or Erosion of Slopes or Abutments	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam DATE 6/30 & 7/14/81

PROJECT FEATURE: DAM NAME RAH, MBP

AREA EVALUATED	CONDITION
CONCRETE DAM (continued)	
Rock Slope Protection - Riprap Failures	N/A
Unusual Movement or Cracking at or near Toes	None
Unusual Downstream Seepage	Seepage through dam with concrete leaching
Piping or Boils	None
Foundation Drainage Features	N/A
Toe Drains	N/A
Instrumentation System	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam — DATE 6/30 & 7/14/81

PROJECT FEATURE: Intake Structure — NAME ____________

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Under water, unknown
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	Under water; unknown
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam — DATE 6/30 & 7/14/81

PROJECT FEATURE: Low Level Outlets — NAME RAH, MBP, EHB

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair
Condition of Joints	N/A
Spalling	None
Visible Reinforcing	None
Rusting or Staining of Concrete	None
Any Seepage or Efflorescence	None
Joint Alignment	N/A
Unusual Seepage or Leaks in Gate Chamber	Partially submerged chamber, probably from leaks through walls
Cracks	None visible
Rusting or Corrosion of Steel	Rungs of ladder on chamber wall are corroded and damaged.

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam DATE 6/30 & 7/14/81

PROJECT FEATURE: Low Level Outlets NAME RAH, MBP, EHB

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER (continued) b. Mechanical and Electrical	
Air Vents	N/A
Float Wells	N/A
Crane Hoist	N/A
Elevator	N/A
Hydraulic System	N/A
Service Gates	4-inch and 18-inch hand operated valves
Emergency Gates	N/A
Lightning Protection System	N/A
Emergency Power System	N/A
Wiring and Lighting System in Gate Chamber	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam DATE 6/30 & 7/14/81

PROJECT FEATURE: Low Level Outlets NAME RAH, MBP, EHB

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Masonry Structure
Rust or Staining	N/A
Spalling	None
Erosion or Cavitation	None
Visible Reinforcing	None
Any Seepage or Efflorescence	None
Condition at Joints	Good
Drain Holes	N/A
Channel	
Loose Rock or Trees Overhanging Channel	Trees and Bushes
Condition of Discharge Channel	Some stones on the channel floor

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam
PROJECT FEATURE: Spillway

DATE 6/30 & 7/14/81
NAME RAH, EHB, JRW

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Lake Naraneka
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	
General Condition of Concrete	Fair
Rust or Staining	None
Spalling	Deterioration at top of pier and corners of abutments
Any Visible Reinforcing	None
Any Seepage or Efflorescence	None
Drain Holes	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam　　　　DATE 6/30 & 7/14/81

PROJECT FEATURE: Spillway　　　　NAME RAH, EHB, JRW

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (continued)	
c. Discharge Channel	Stone paved channel
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees and brush along entire length of channel
Floor of Channel	Slight heaves in channel floor and open joints between stone masonry.
Other	Seepage at the end of channel

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam DATE 6/30 & 7/14/81

PROJECT FEATURE: ______ NAME ______

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	N/A
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	N/A
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

PERIODIC INSPECTION CHECK LIST

PROJECT: Lake Naraneka Dam DATE 6/30 & 7/14/81

PROJECT FEATURE: ______________ NAME ______________

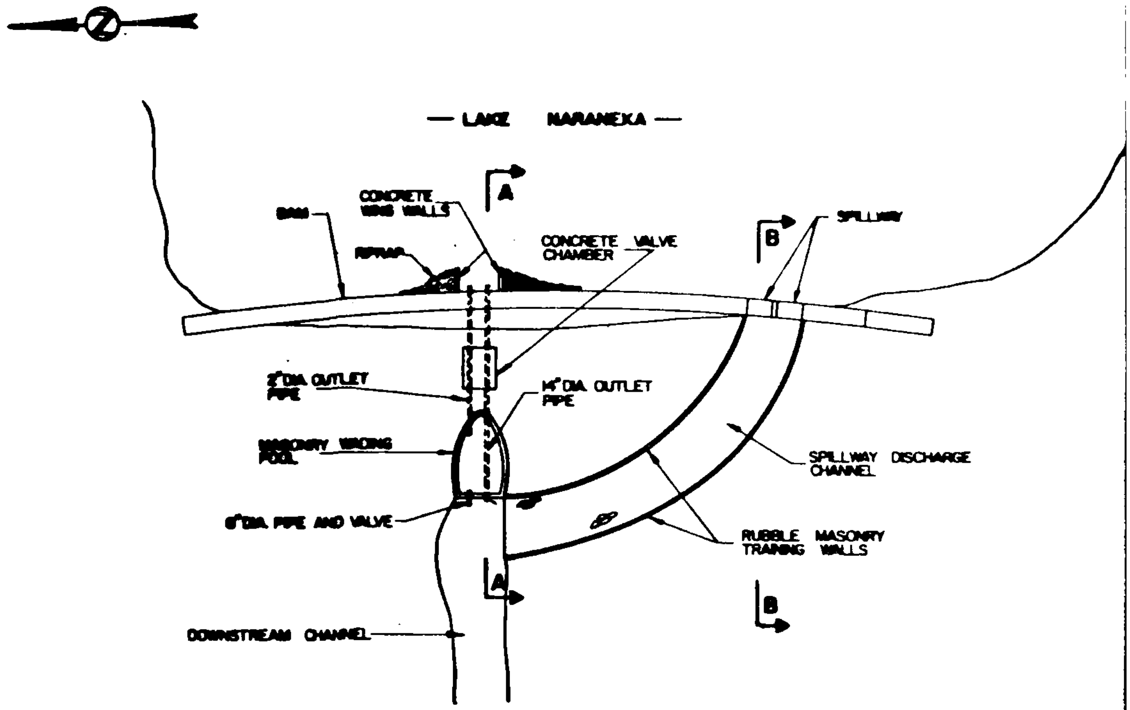
AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General condition of Concrete	N/A
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering or Monoliths	

APPENDIX B

ENGINEERING DATA

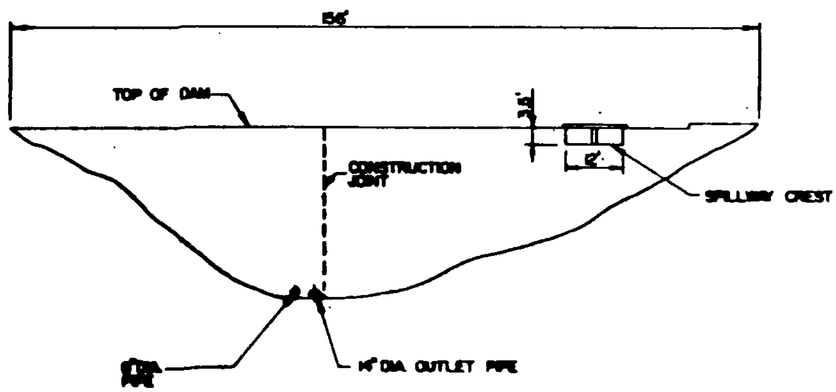
SUMMARY OF DATA AND CORRESPONDENCE

DATE	TO	FROM	SUBJECT	PAGE
8/81	----	----	Plan, Profile and Sections	B-2
7/81	----	----	Twixt Hills Dam Repair Plan	B-3
4/77	----	----	Water Resources Inventory Data	B-5
5/70	Mr. James D. Gregory Attorney at Law Represents Twixt Hills Home Owner's Association	William H. O'Brien III Civil Engineer	Schedule Inspection	B-9
6/10/63	Water Resources Commision	S.E. Muchemore Associates Consulting Engineers	Inspection Results	B-10
6/10/63	Mr. Jerry Tuccio Twixt Hills Home Owner's Association	Water Resources Commission Emitt A. Dell Field Inspector	Inspection Report Transmittal Letter	B-11
6/7/63	Water Resources Commission Emitt A. Dell	S.E. Muchemore Associates Consulting Engineers	Confirmation of Inspection	B-13
6/3/63	S.E. Muchemore Associates Consulting Engineers	Water Resources Department Emitt A. Dell	Request to Inspect Dam	B-14
1/38	----	Samuel W. Hout, Jr. Co., Inc. Engineers and Surveyors	As-Built; Plan, Elevations and Section	B-15



PLAN

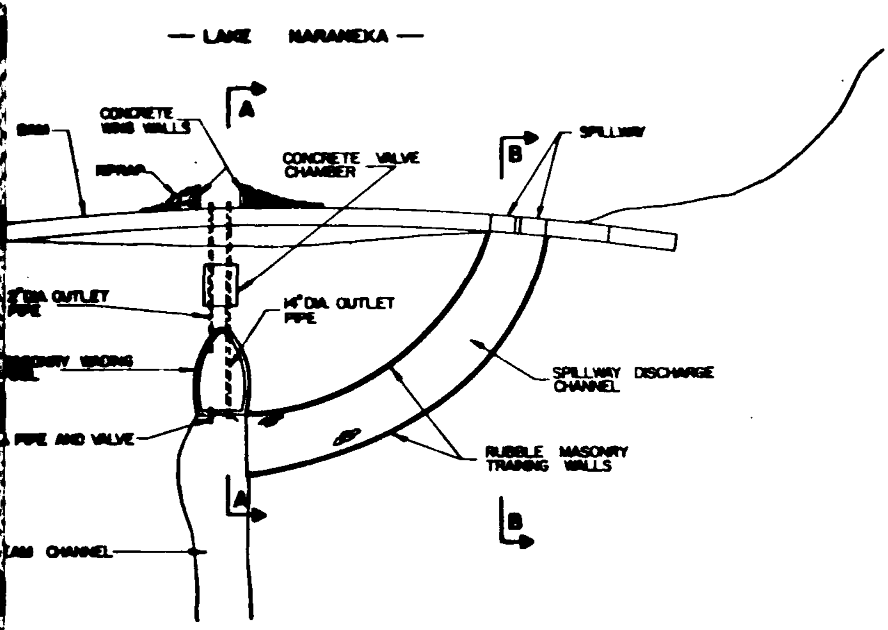
0 20' 40' 60'



DOWNSTREAM ELEVATION

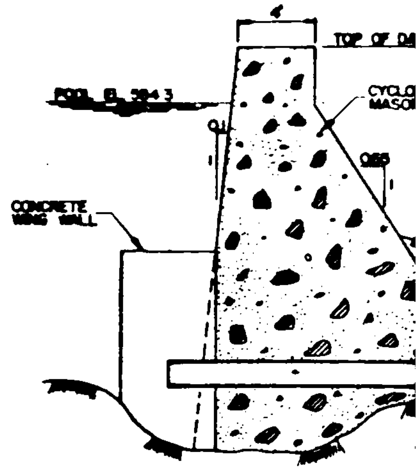
HORIZONTAL 0 20' 40' 60'

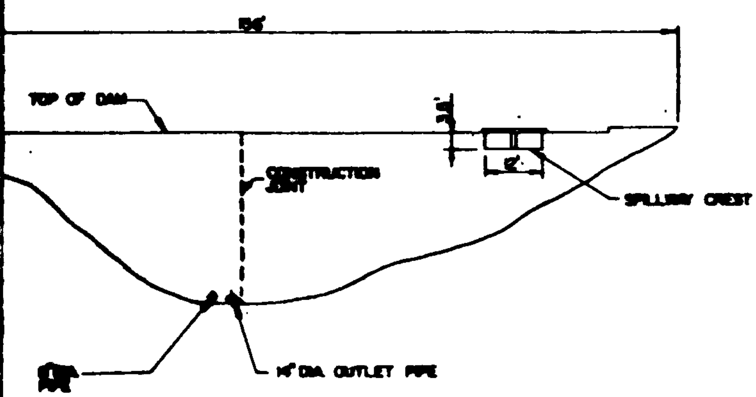
VERTICAL 0 10' 20' 30'



PLAN

0 20' 40' 60'

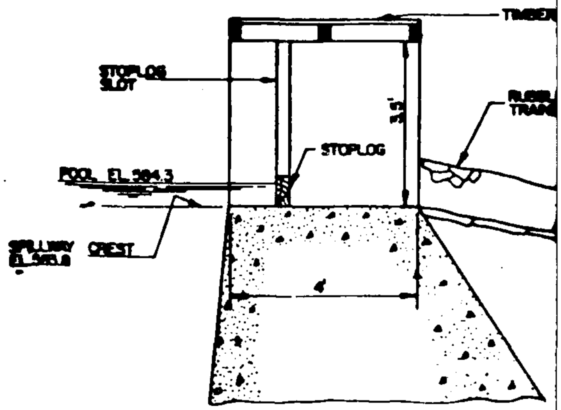




DOWNSTREAM ELEVATION

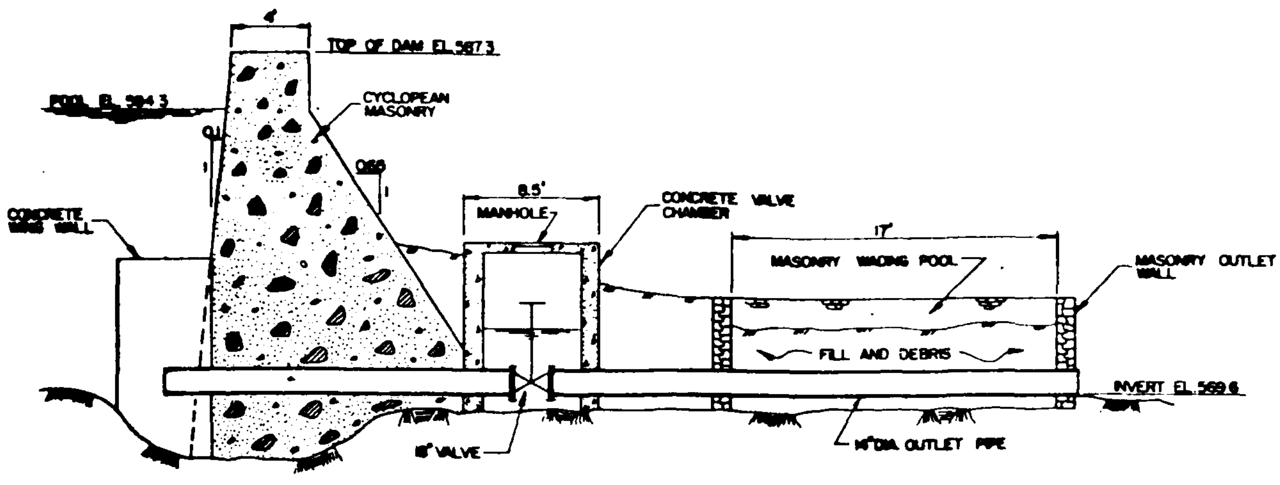
0 20' 40' 60

0 10' 20' 30'



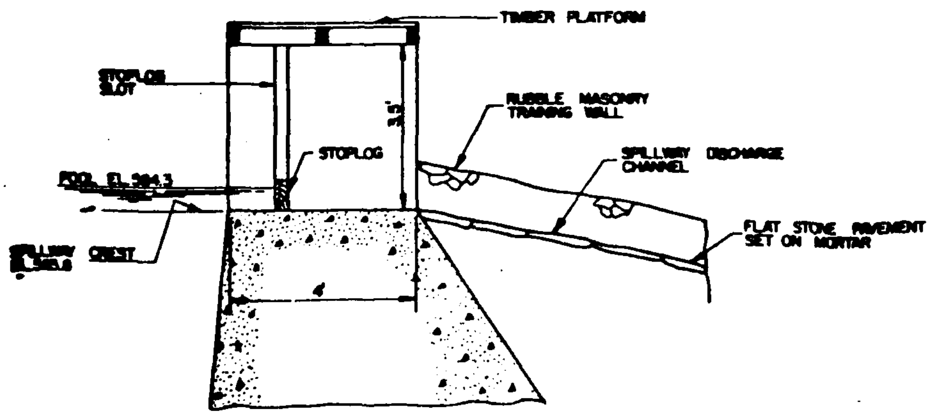
SECTION B-B

0 2' 4' 6'



SECTION A-A

0 5' 10' 15'



SECTION B-B

0 2' 4' 6'

NOTES:

1. THIS PLAN WAS COMPILED FROM THE AS-BUILT DRAWING PREPARED BY SAMUEL W. HOYT JR., CO., INC. AND SUPPLEMENTARY MEASUREMENTS MADE BY IECO ENGINEERS.
2. ALL ELEVATIONS WERE REFERENCED TO THE NORMAL SPILLWAY CREST ELEVATION WHICH WAS ASSUMED TO CORRESPOND TO THE WATER SURFACE ELEVATION SHOWN ON THE TOPOGRAPHIC MAP OF THE TOWN OF RIDGEFIELD (1974).

INTERNATIONAL ENGINEERING CO. DARIEN, CONNECTICUT ENGINEER	U.S. ARMY ENGINEER DIV. NEW E... CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL ...

PLAN, ELEVATION, AND SECTIONS

LAKE NARANEKA DAM

MAMANASCO BROOK — RIDGEFIELD, CONNECTICUT

DRAWN BY	CHECKED BY	APPROVED BY	SCALE AS NOTED	
[signature]	P.V.S.	[signature]	DATE JULY, 1981	SHEET B-...

Twin Hills Dam Repair Plan

July General Membership Meeting – Present dam repair plan to general membership for approval.

July

Organize working parties from THHCA membership to do dam preparation work:

- identify a volunteer foreman for each work party.
- identify 6-10 workers per work party.
- 3 hours of work per family
- schedule work parties on both Saturday and Sunday
- working schedules: 9-12 & 1-4

July, August, & September

Conduct working parties:

- block off dam to prevent crossing during period of repairs.
- buy tools (chipping hammers and wire brushes) or borrow from contractor.
- chip away all loose material and wire brush surfaces.
- cut off old sliding head metal bolts at top of dam.

Conduct wrecking parties (continued)
- safety glasses required.
- cut down small trees growing at base and sides of dam.
- chipped away material to be cleaned up daily and transported to dump.

5 September 1981

Open valve to lower level of the lake.

September 1981

- Complete preparation of dam below summer's higher water level.

- Contractor builds forms and pours concrete to return dam to original external appearance.

- Contractor patches areas not requiring forms.

- Remove barriers

Other

- Water level remains at lower level throughout the winter.

No. ________

Inventoried By ________

Date ________

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

CT-

WESTERN

Name of Dam or Pond PIERREPONT LAKE also known as Lake Naranek

Code No. TT 1.7 U0.5

Nearest Street Location ________

Town Ridgefield

U.S.G.S. Quad. Peach Lake NY-Ct   Long 73-30.

Name of Stream ________   LAt 41-19.5

Owner Twixt Hills Home Owner Assoc

Address Pres. = Harry Batastini

Pond Used For recreation

Dimensions of Pond: Width ________ Length ________ Area 33.0

Total Length of Dam 195'   Length of Spillway 15'

Location of Spillway southern end

Height of Pond Above Stream Bed 8'

Height of Embankment Above Spillway 3.5'

Type of Spillway Construction Conc. paved channel

Type of Dike Construction Concrete gravity section

Downstream Conditions Wood, swamps

Summary of File Data ________

Remarks ________

BUILT 1937

DOWNSTREAM HAZARD 01

Would Failure Cause Damage? No   Class A

Tilly? [illegible]

Lawyer | MR Jim Gregory 438-4584

President | MR. Harry Batastini 438-6742

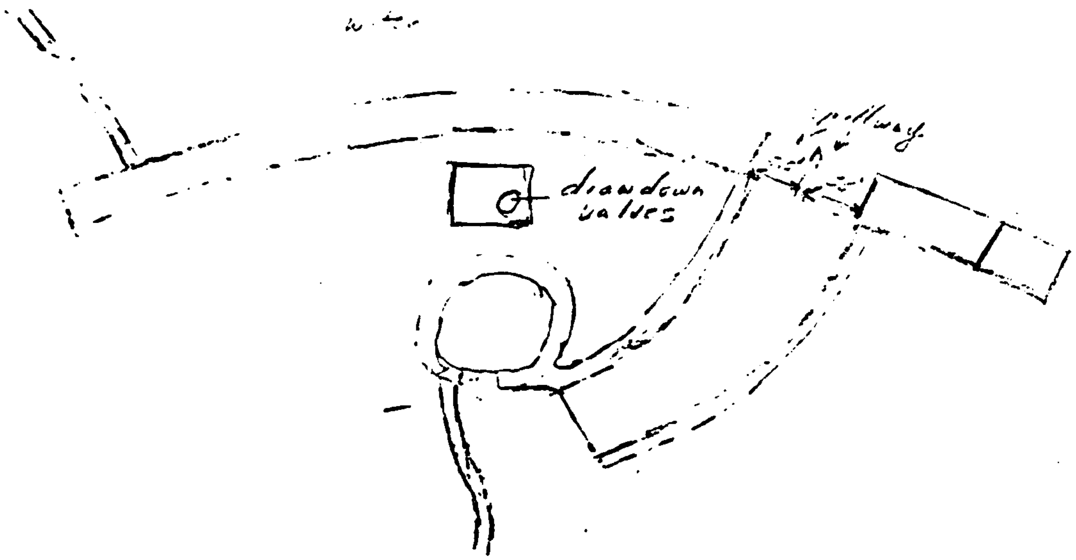
MR. John McMurray 438-4360

State [illegible]

[illegible]

[illegible]

center and along [illegible]terline. Heavy checking on toe of dam near center also. [illegible] about 20' down from the dam.



Twixt Hills Home Owner Assoc.
Ranger Mr Jim Gregory 438-4584
John McMurray 430-4360
Barlow Mt Rd.

Directions:

going north on Rt 116 from Ridgefield take Barlow Mtn. Rd (a right). Easiest entrance is through Kenndys yard

56

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

No. ________

35 Inventoried By ________

Date ________

Name of Dam or Pond PIERREPONT LAKE

Code No. R-56

Nearest Street Location BARLOW MT. RD

Town Ridgefield

U.S.G.S. Quad. PEACH LAKE NY - CT.

Name of Stream UNAMED TRIB. TITICUS R.

Owner ________

Address ________

Pond Used For REC.

Dimensions of Pond: Width ______ Length ______ Area 33 A

Total Length of Dam 250' Length of Spillway 12'

Location of Spillway SOUTHERN END OF DAM ON N.W. SIDE OF LA

Height of Pond Above Stream Bed 20'

Height of Embankment Above Spillway 42"

Type of Spillway Construction CONCRETE

Type of Dike Construction "

Downstream Conditions ROAD WITH 2'x3' SQUASH PIPE + SWAMPY AREA

Summary of File Data ________

Remarks ________

4-7-77 APPEARS SAFE - MED HAZARD BECAUSE OF SIZ

Would Failure Cause Damage? YES Class ____

May 6, 1970

Mr. James P. Gregory
Attorney at Law
Pierrepont Drive
Ridgefield, Connecticut 06877

Re: Pierrepont Lake Dam
Ridgefield

Dear Mr. Gregory:

We have your letter of April 30, 1970 concerning the subject dam.

When this dam was inspected last it was the opinion of the inspector that this dam would not cause damage in the event of failure, however the situation may have changed. We will plan to inspect this dam the next time we are in the Ridgefield area and would expect that this would be within approximately one month, unless you feel that the situation demands greater urgency. We will advise you when we will be in the area so that you may make arrangements to be there.

In reference to the Algae and Weed problems we expect that the town may be treating Mamanasco Lake and requesting reimbursement this year. Perhaps when our consultant is in the area he could also look at your lake and offer his comments. Our only program with Algae at the present time is under Section 25-3c of the General Statutes, a copy of which is enclosed for your information, which deals with the reimbursement of towns for the treatment of bodies of water in the State of Connecticut. If you have further questions please advise.

Very truly yours,

William H. O'Brien III
Civil Engineer

WHOIII/leh
Enclosure

MEMBER, CONSULTING ENGINEERS COUNCIL

TELEPHONE TOWNSEND 9-6164

S. E. MUCHEMORE ASSOCIATES
CONSULTING ENGINEERS
6 W. PUTNAM AVE. GREENWICH, CONNECTICUT

June 10th 1963
Page 1

Water Resources Commission
State of Connecticut
State Office Building
Hartford 15 Connecticut

Attention Mr. Emitt Dell

Report on
Pierrepont Lake Dam
Ridgefield, Connecticut

Gentlemen;

In compliance with your instructions to the writer, the writer made a trip on June 6th 1963 to inspect the above dam.

We meet a Mr. Jerry Juccio of Ridgefield the owner of the dam by appointment to conduct us around the property.

The Pierrepont Lake is located about one mile north of the U.S. 33&7 junction on Mountain Road. This lake is located in a series of connecting valleys and ponds. The water shed area is about .33 sq. mile with a normal spillway discharge of about .5 c.f. per s.. This lake is spring feed and is the first in a series of lakes and ponds feeding the Saugatuck Reservoir. The topography is hilly and wooded with a minimum of houseing.

We are informed that the Pierrepont Dam was designed by Mr. Samuel B. Hoyt C.E. of Norwalk Conn. and that this dam was approved by the State of Connecticut in the year 1937.

The pierrepont lake is kidney shaped and is about 2000 feet long and 2000 feet wide.

MEMBER, CONSULTING ENGINEERS COUNCIL TELEPHONE TOWNSEND 9-6164

S. E. MUCHEMORE ASSOCIATES
CONSULTING ENGINEERS
6 W. PUTNAM AVE. GREENWICH, CONNECTICUT

June 10th 1963

Water Resources Commission
State of Connecticut

Report on
Pierrepont Lake Dam
Ridgefield, Connecticut

The dam was designed as a concrete gravity dam on an arched plan and could be considered a combined design. Both ends of the dam are anchored into the rock substrata banks. The arch ends are downstream. The approximate dimensions are as follows – Length about 195'-0", width of top 4'-0", estimated base at bottom calculated from slope of downsteam face. 15'-0". This dam is about 14'-0" high at c.l. on downstream face.

The spillway is located about 30'-0" from the north end of the dam and is 15'-0" wide and 42" deep. At present there is 12 inches of stop logs on the bottom of the spillway leaving 30 inches of free-board. The spillway is protected with a properly designed metal screen.

After a careful check of the concrete in this twenty six year old dam we find the concrete in very good condition with some minor spalling and weathering on the top.

This dam is in a good stable condition and shows no signs of stress.

There are no signs of percolation downstream.

We would recommend that the owner be instructed to continue maintenance of dam and to repair the spalled sections.

Respectfully submitted

Steve Muchemore C. E.

SEM/af

STATE OF CONNECTICUT
E. MUCHEMORE, JR.
No. 192
PROFESSIONAL ENGINEER

18

June 10, 1963

Pierrepont Lake Dam
Ridgefield

Mr. Jerry Tuccio
24 West Mountain Road
Ridgefield, Connecticut

Dear Mr. Tuccio:

You are, no doubt, in receipt of a report on your dam by S. E. Muchemore Associates. You will note in the last paragraph it states: "We would recommend that the owner be instructed to continue maintenance of dam and to repair the spalled sections." Kindly notify this office as to your plans on this project.

Very truly yours,

Emitt A. Dell
Field Inspector

EAD:js

MEMBER CONSULTING ENGINEERS COUNCIL

TELEPHONE TOWNSEND 9-6164

S. E. MUCHEMORE, C. E.
CONSULTING ENGINEER
6 WEST PUTNAM AVE. GREENWICH, CONNECTICUT

June 7th 1963.

Mr. Emett Dell.
Water Resources Comm.
State of Conn.

STATE WATER RESOURCES COMMISSION
RECEIVED
JUN 10 1963
ANSWERED..........
REFERRED..........
FILED..........

Dear Emett:

After our inspection of the Pierrepont Lake Dam Mr. Jerry Tuccio informed me that he had agreed to pay for this inspection to expedite the report with the Water Resources Commission.

Therefore we accepted his check for our standard fee and will not bill the State as customary.

Sincerely hoping this is all right.

Regards.

Steve Muchemore

June 3, 1963

Mr. Steven Muchemore
Consulting Engineer
6 West Putnam Avenue
Greenwich, Connecticut

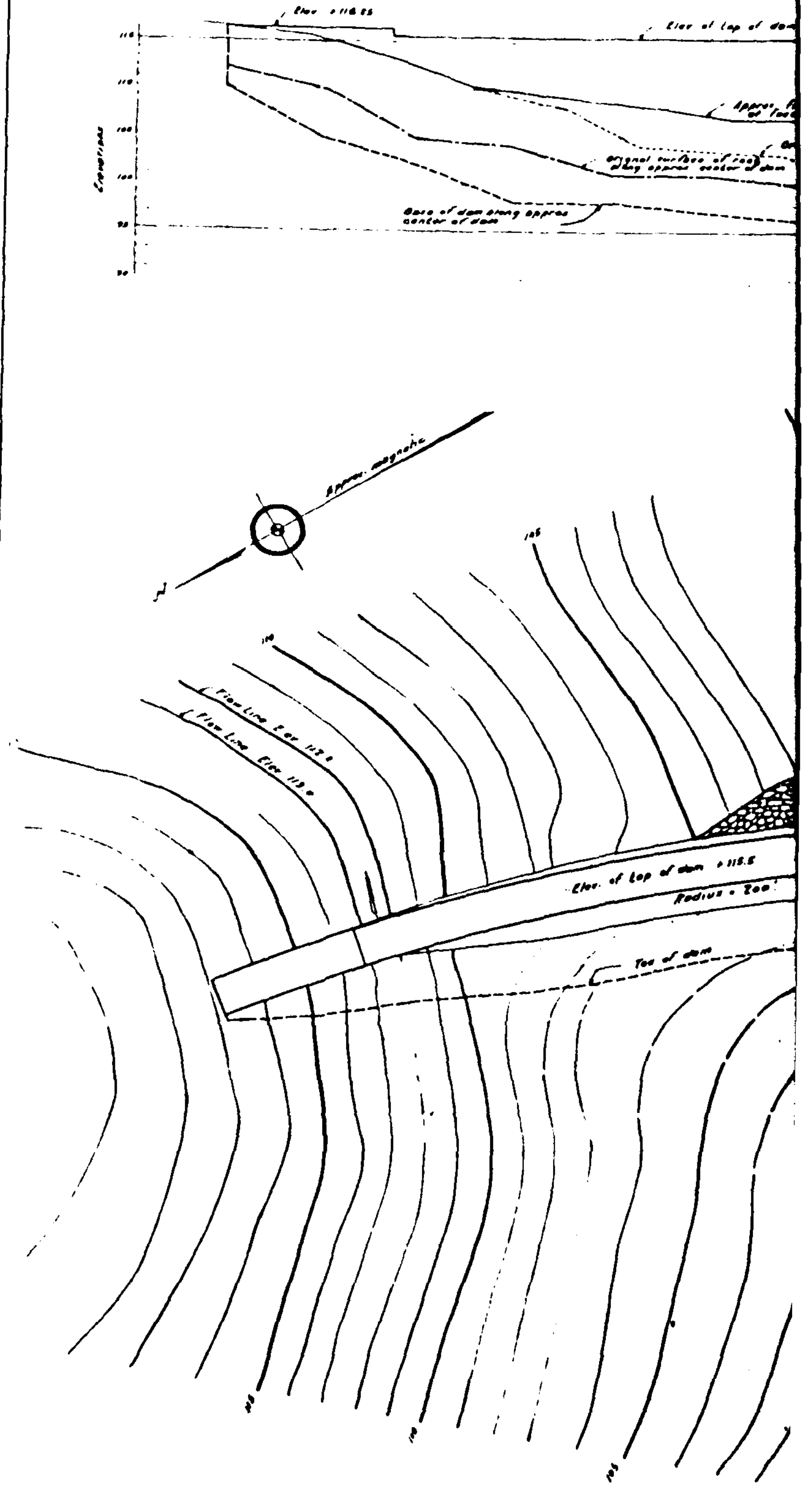
Dear Mr. Muchemore:

Under your terms as a consultant to this office, would you kindly inspect the dam at Pierpoint Pond in the Town of Ridgefield and submit a report to this office stating the owner, condition of dam, and what action, if any, this Commission should take on this project.

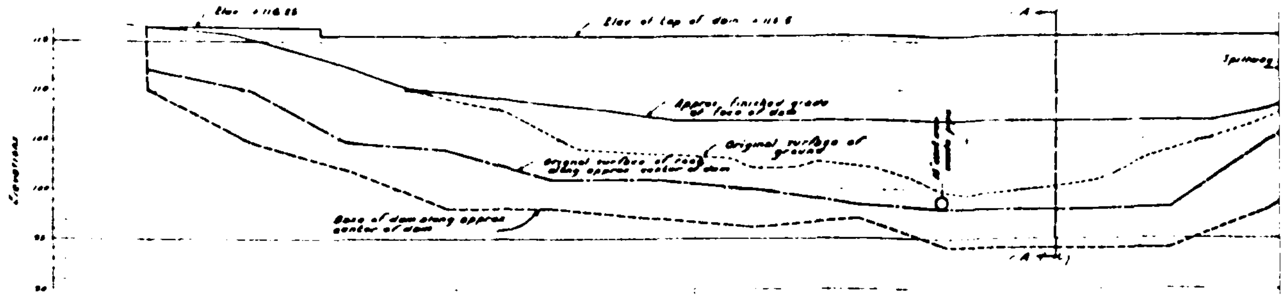
Very truly yours,

Emitt A. Dell
Field Inspector

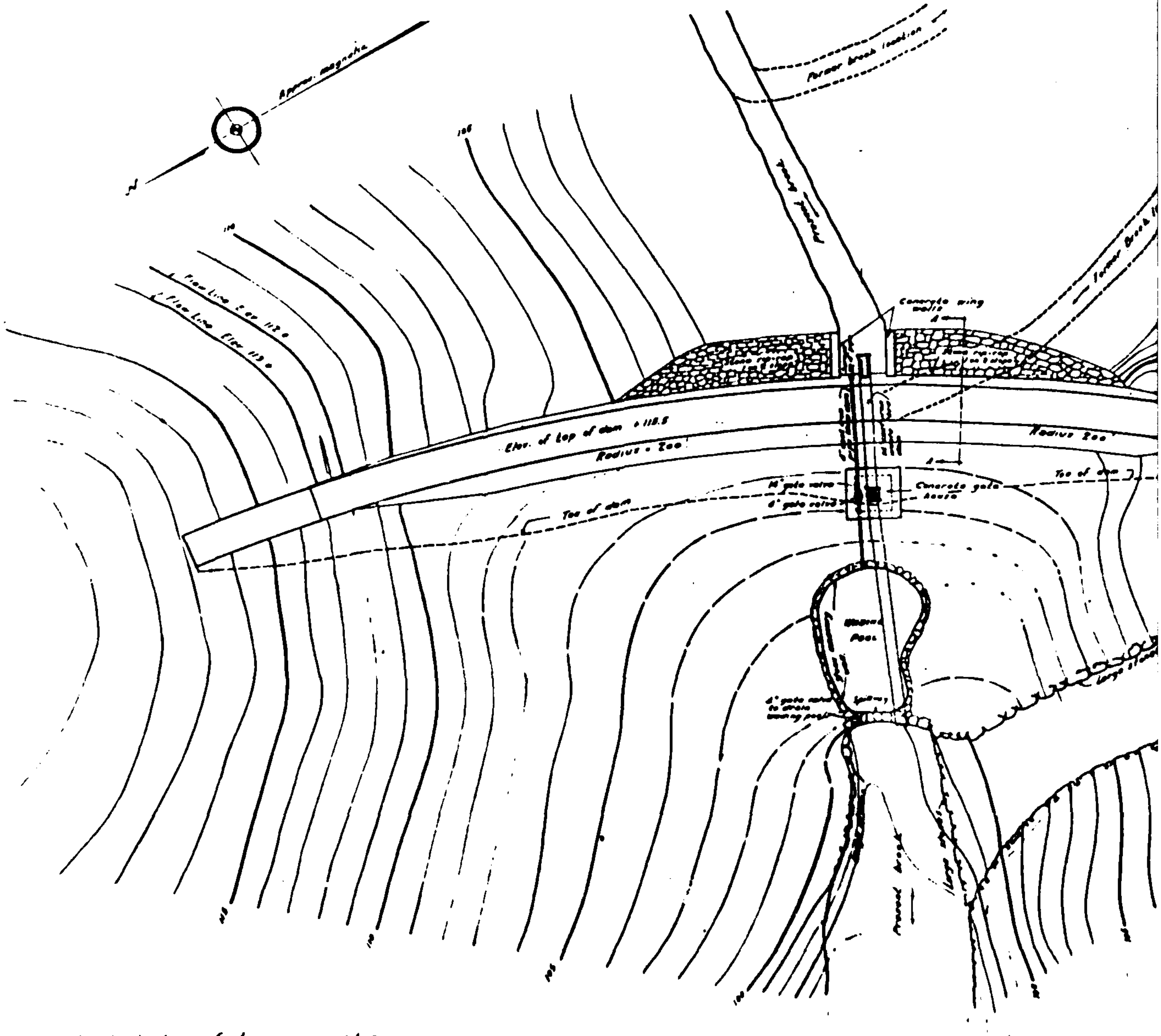
EAD:js



Note: All elevations refer to an assumed datum

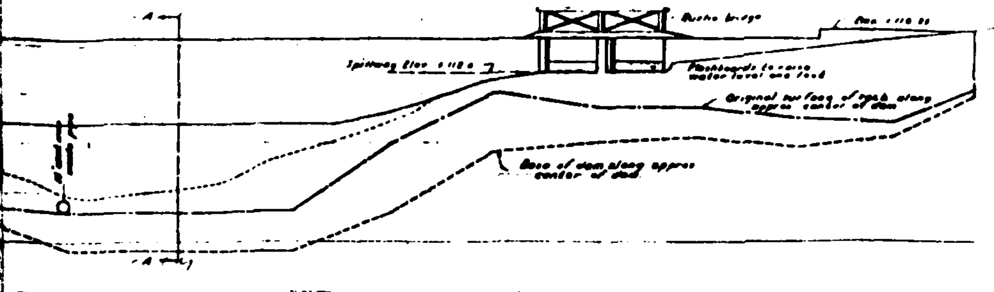


ELEVATION OF DAM
Scale 1/8" = one ft.



note.. All elevations refer to an assumed datum

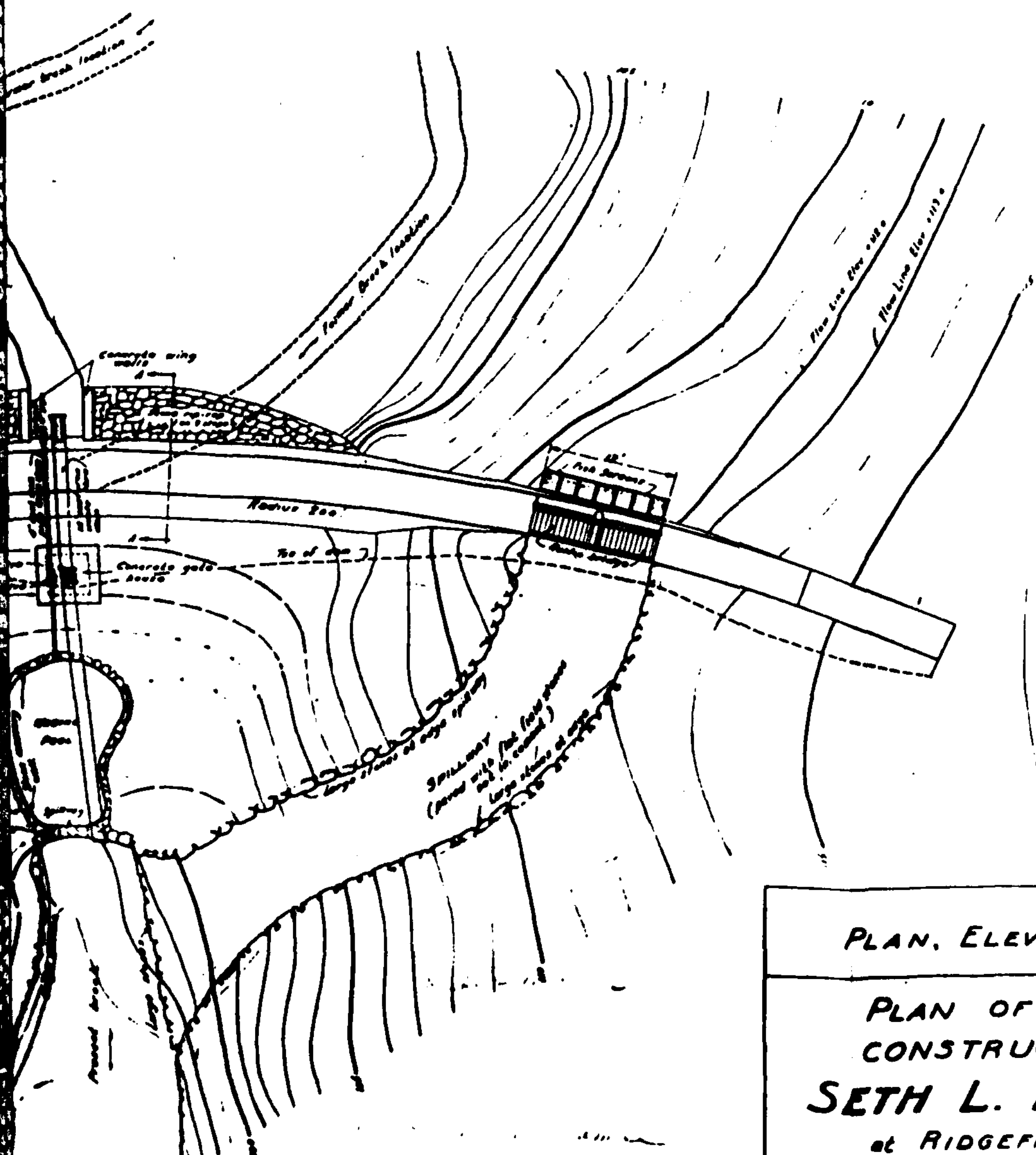
PLAN OF DAM
Scale 1/8" = one foot



...TION OF DAM
1/8" = one ft.

SECTION A-A

Typical Section thru Dam
(Shape of base varies throughout)



...N OF DAM
1/8" = one foot

PLAN, ELEVATION & SECTION.

PLAN OF DAM AS CONSTRUCTED FOR

SETH L. PIERREPONT

at RIDGEFIELD, CONN.

JAN. 1938. Scale 1" = 100 ft	SAMUEL W HOYT, JR. CO. INC Engineers and Surveyors So. Norwalk, Conn

APPENDIX C

PHOTOGRAPHS

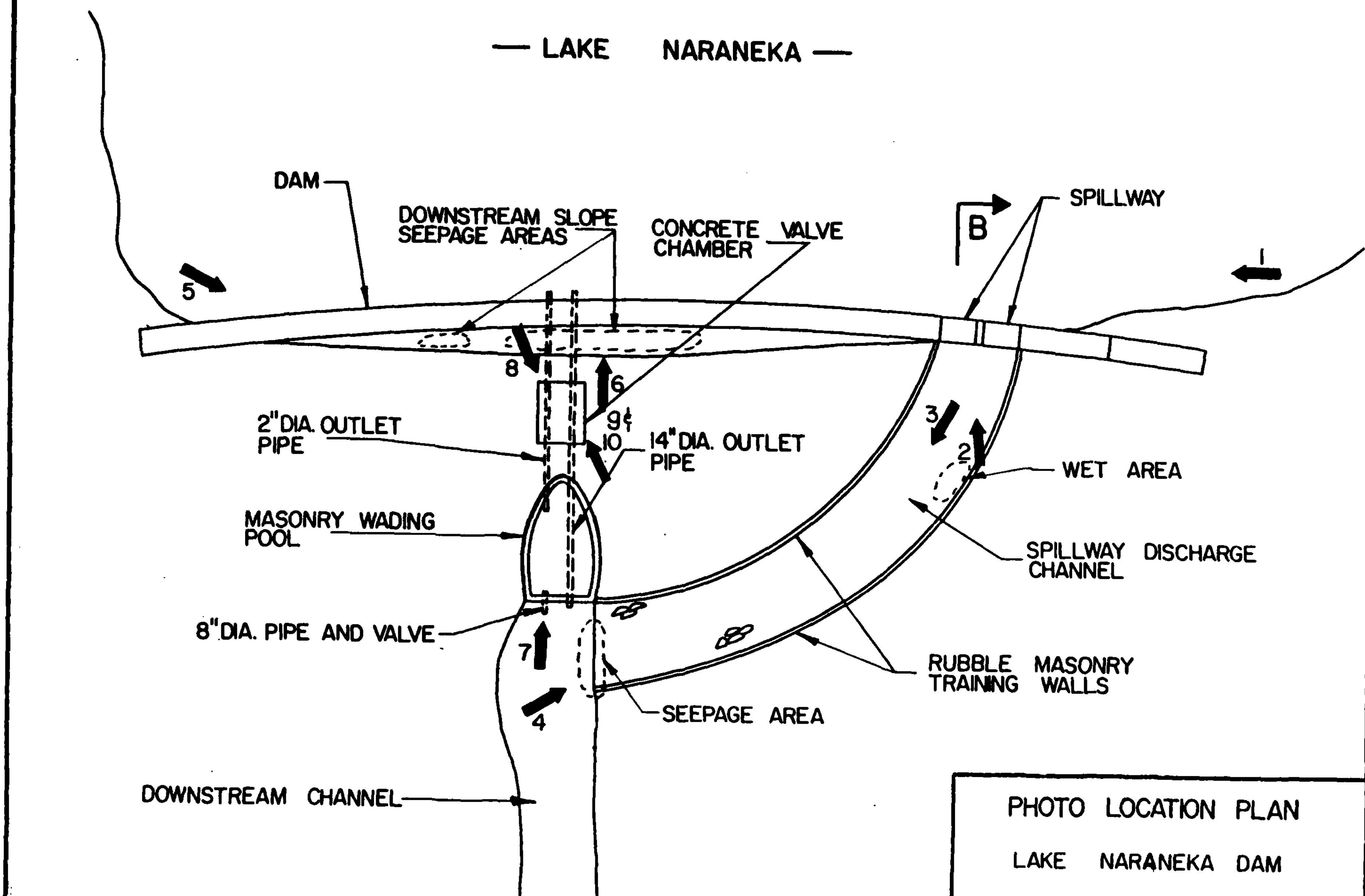


PHOTO LOCATION PLAN

LAKE NARANEKA DAM

Photo 1 Top and Upstream Face of Dam and Spillway Structure

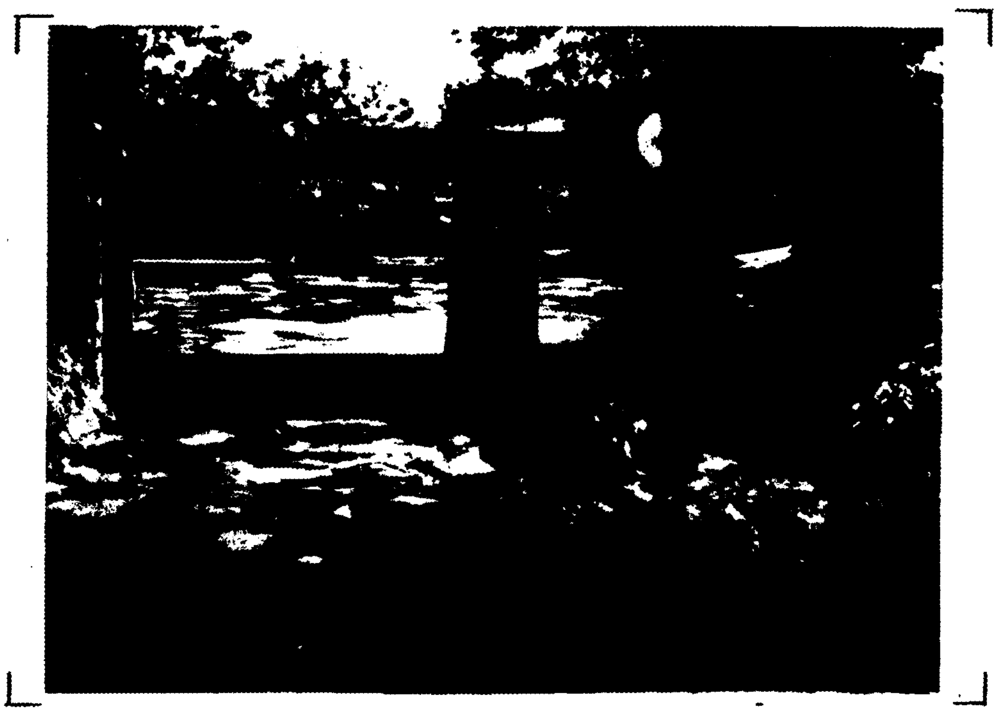


Photo 2 Spillway Crest and Stoplogs

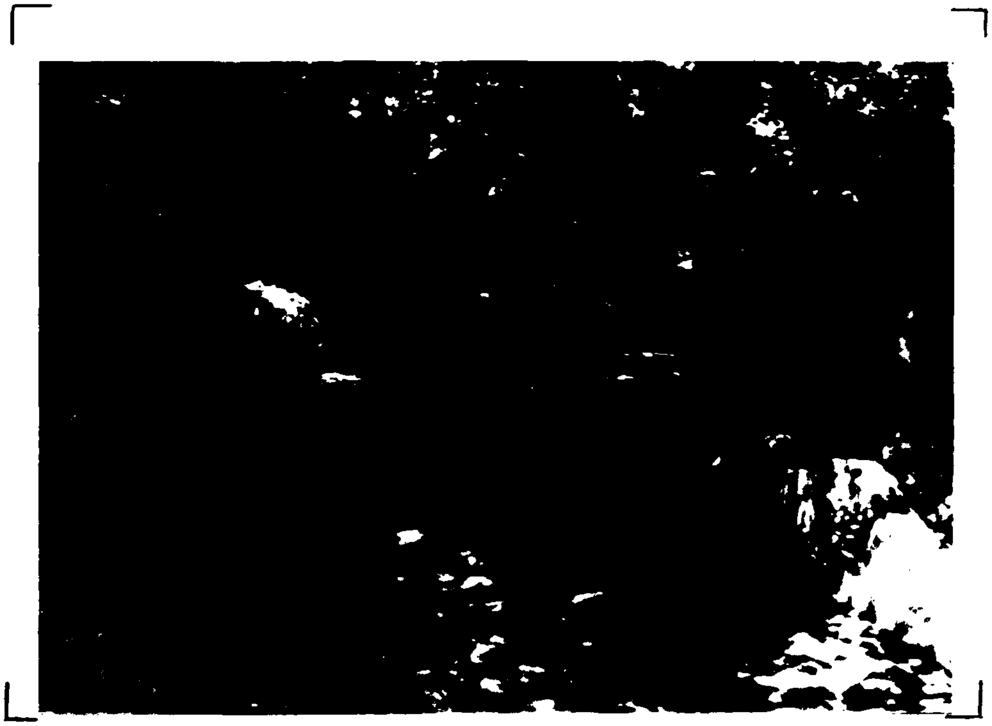


Photo 3 Spillway Discharge Channel

Photo 4 Seepage at End of Spillway Discharge Channel

Photo 5 Concrete Deterioration on Upstream Face of Dam

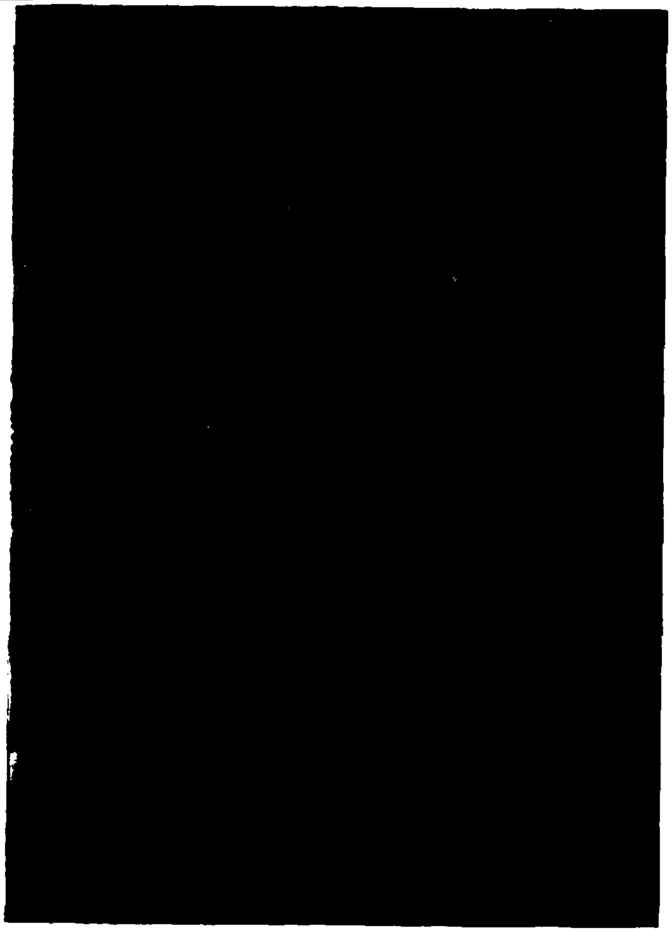


Photo 6 Seepage and Concrete Deterioration on Downstream Face of Dam

Photo 7 8-inch and 16-inch outlet conduits and outlet masonry wall.

Photo 8 Concrete valve chamber.

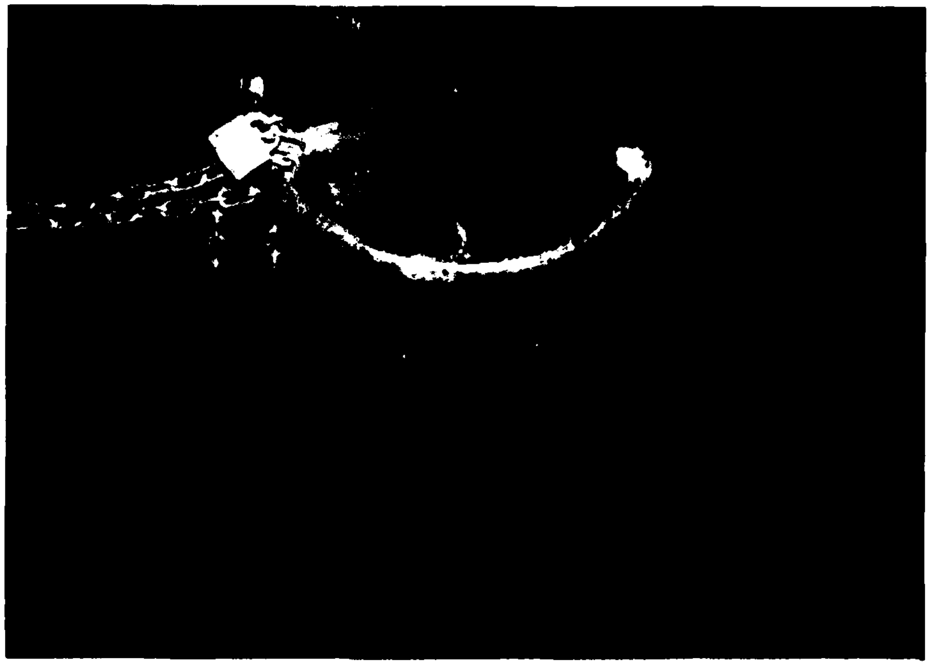


Photo 9 Hand operated gate valve in valve chamber.

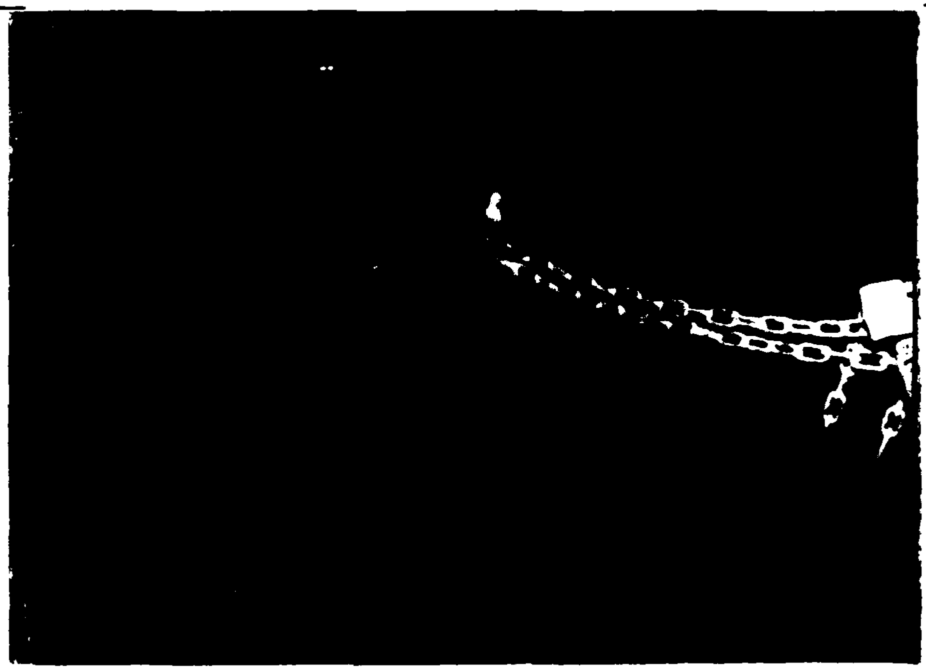
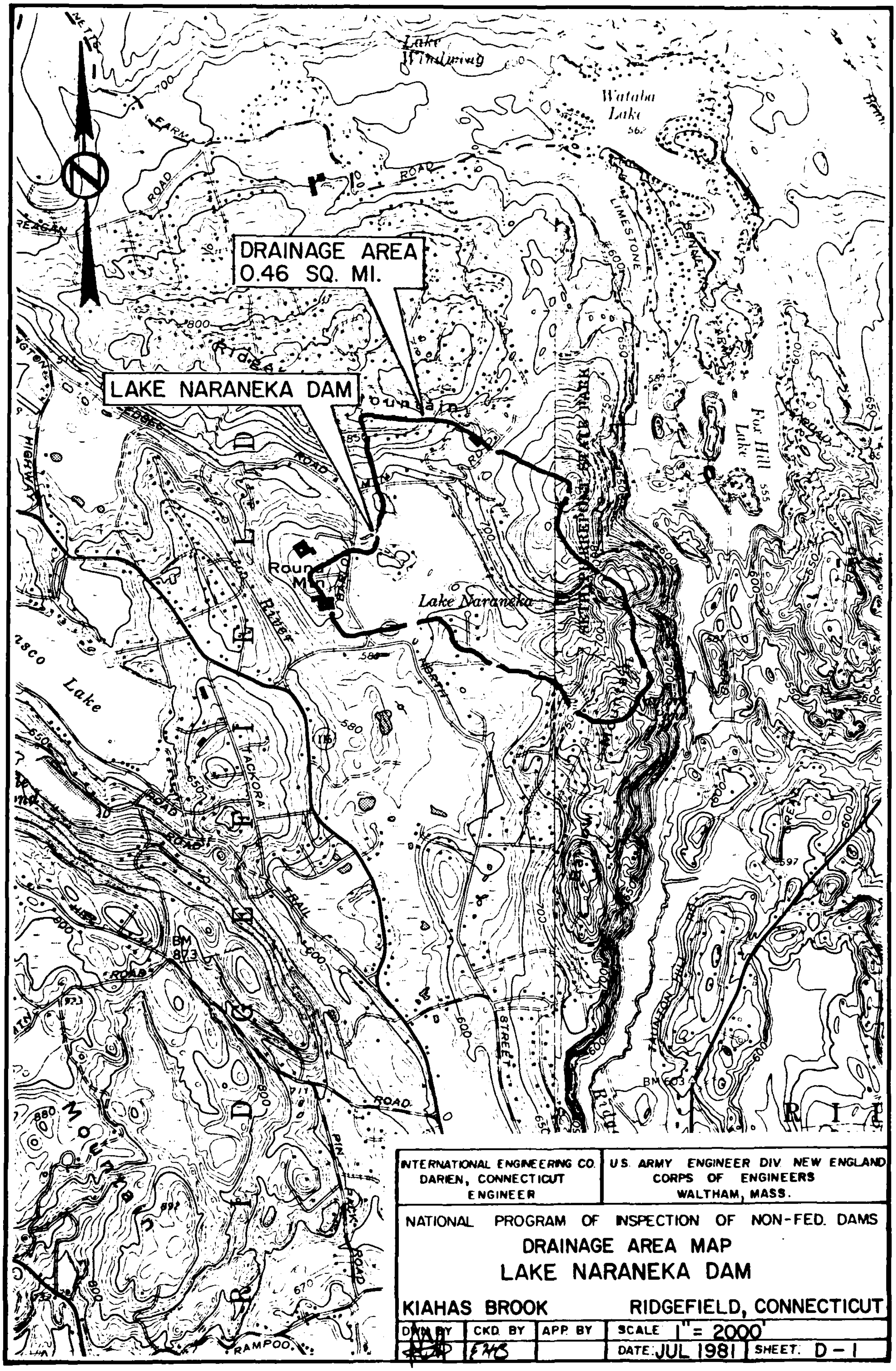
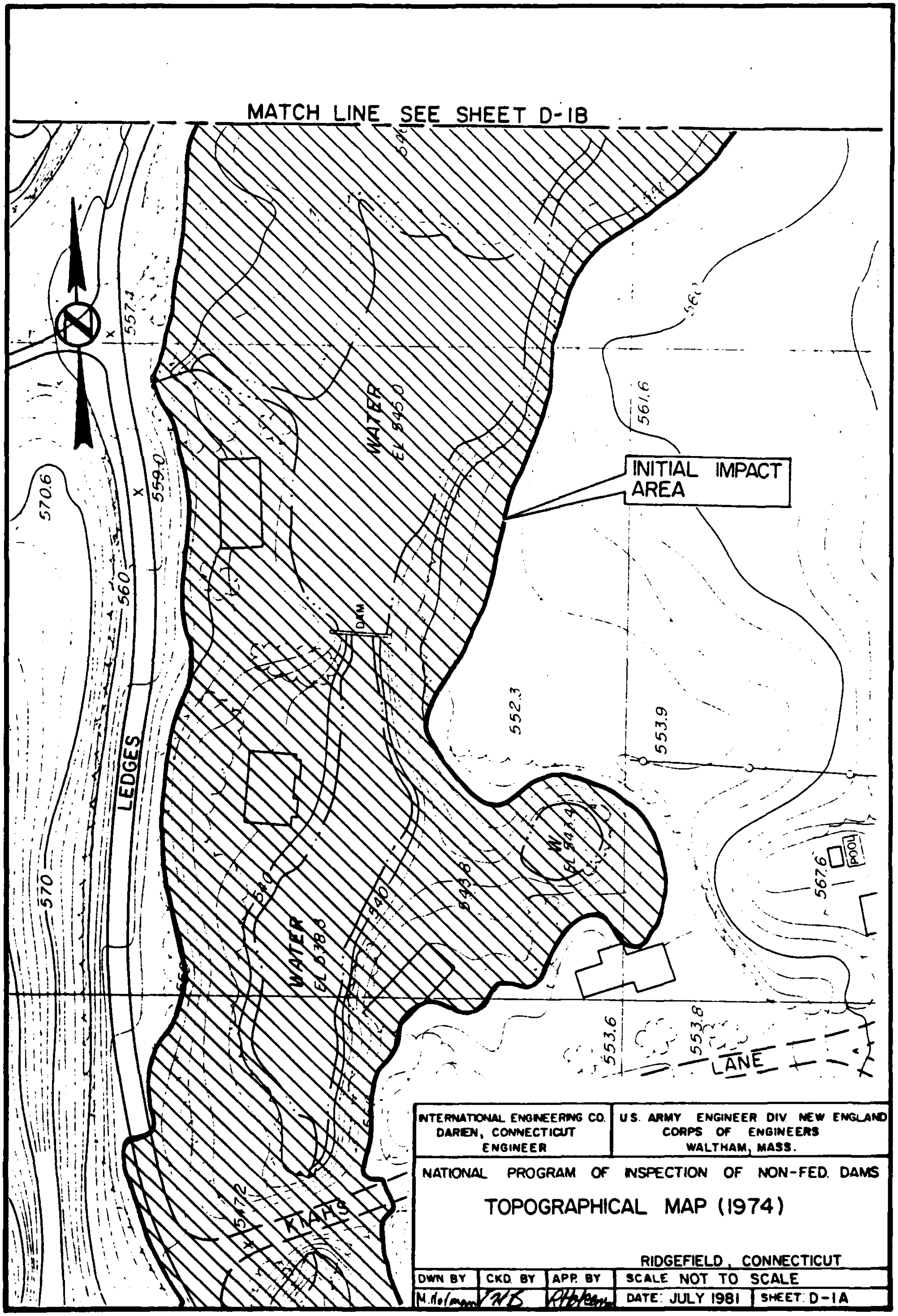


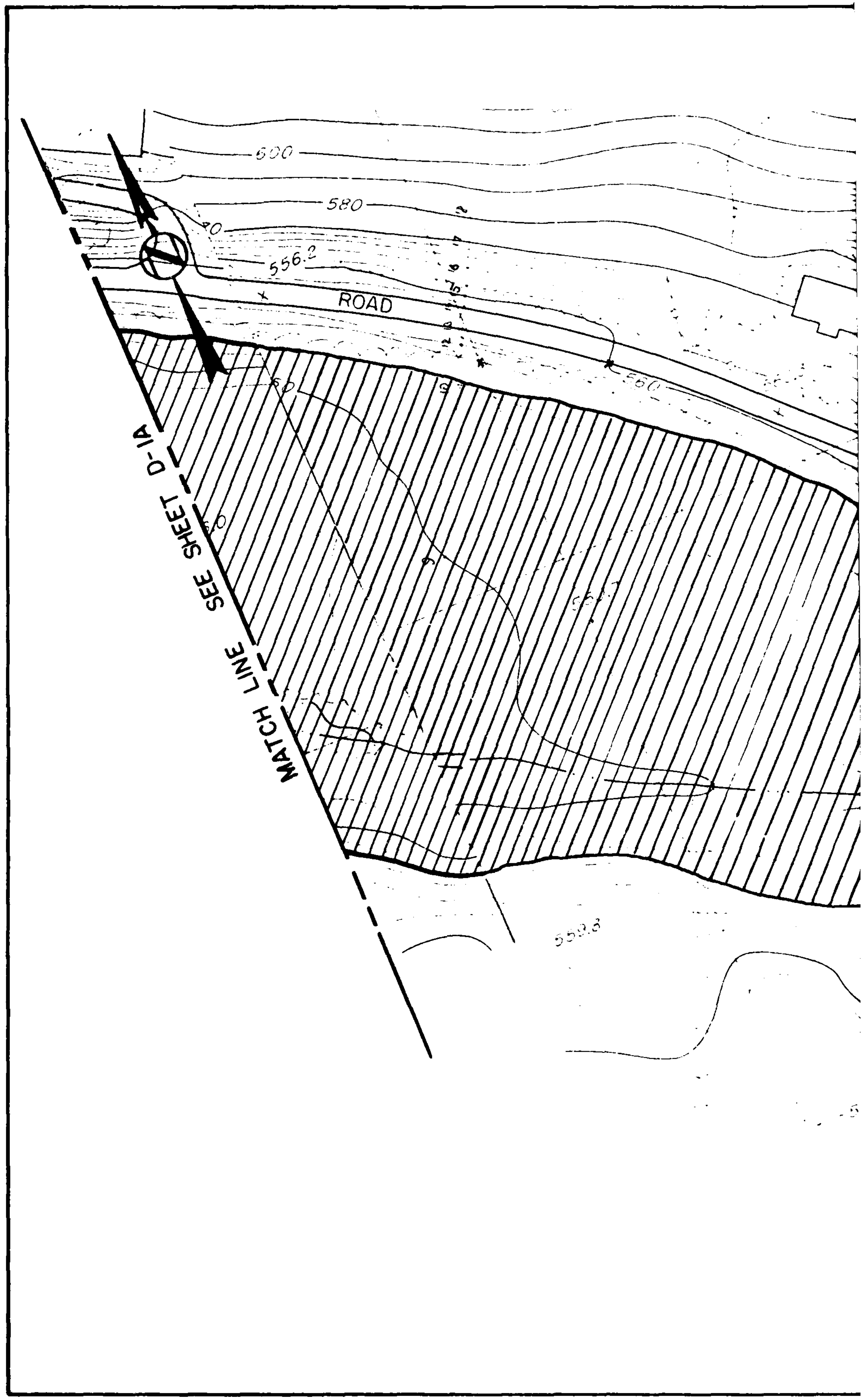
Photo 10 Hand operated gate valve in valve chamber.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

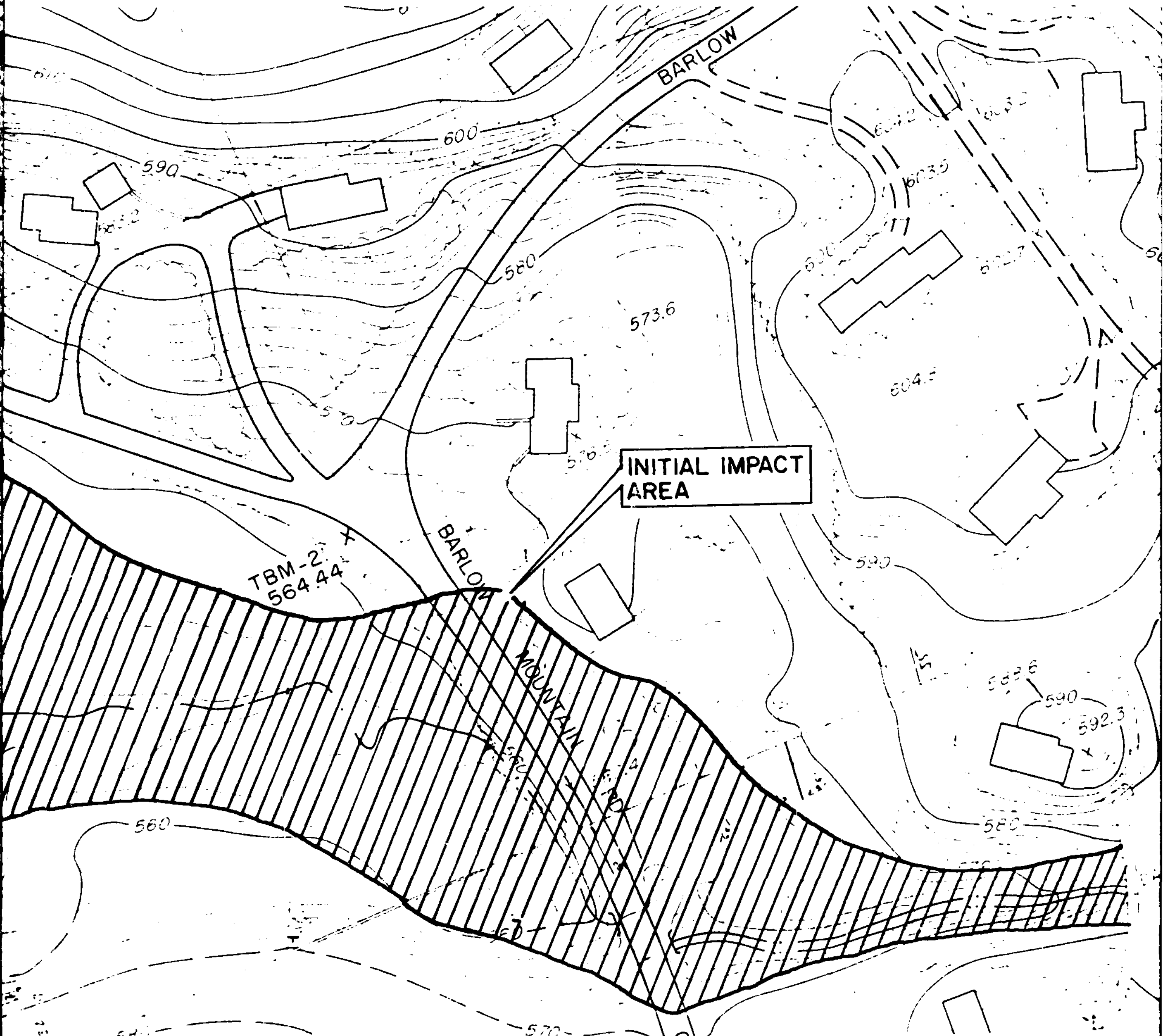

DRAINAGE AREA
0.46 SQ. MI.
LAKE NARANEKA DAM
Lake Naraneka
Round Mtn
Lake Windwing
Wataba Lake
Fox Hill Lake
LIMESTONE
ROAD
FARM
REAGAN
HIGHWAY
TACKORA
TRAIL
STREET
RAMPOO
BM 873
BM 603
INTERNATIONAL ENGINEERING CO.
DARIEN, CONNECTICUT
ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
DRAINAGE AREA MAP
LAKE NARANEKA DAM
KIAHAS BROOK
RIDGEFIELD, CONNECTICUT
DWN BY
CKD. BY
APP. BY
SCALE 1" = 2000'
DATE: JUL 1981
SHEET: D - 1


MATCH LINE SEE SHEET D-1B
557.4
559.0
570.6
560
570
LEDGES
WATER
EL 545.0
DAM
WATER
EL 538.5
540
543.8
INITIAL IMPACT AREA
561.6
552.3
553.9
567.6
POOL
553.6
553.8
LANE
KNAPS
INTERNATIONAL ENGINEERING CO.
DARIEN, CONNECTICUT
ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
TOPOGRAPHICAL MAP (1974)
RIDGEFIELD, CONNECTICUT
DWN BY
CKD. BY
APP. BY
SCALE NOT TO SCALE
DATE: JULY 1981
SHEET: D-1A



600
580
556.2
ROAD
560
MATCH LINE SEE SHEET D-IA

600
580
556.2
ROAD
560
560.3
590
MATCH LINE SEE SHEET D-IA
559.8
570



INTERNATIONAL ENGINEERING CO DARIEN, CONNECTICUT ENGINEER	US ARMY ENGINEER DIV NEW ENGLA[ND] CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAM[S]

TOPOGRAPHICAL MAP (1974)

RIDGEFIELD, CONNECTICU[T]

DWN BY	CKD BY	APP BY	SCALE NOT TO SCALE	
			DATE JULY 1981	SHEET D-1B

INTERNATIONAL ENGINEERING COMPANY, INC.

Project NON-FEDERAL DAM INSPECTION	Contract No. 2616	Sheet D-2	File No.
Feature LAKE NARANEKA DAM	Designed EHB	Date 7/22/8	
Item	Checked	Date	

HYDROLOGIC / HYDRAULIC INSPECTION

LAKE NARANEKA DAM, RIDGEFIELD, CONNECTICUT

1) PERFORMANCE AT PEAK FLOOD CONDITIONS

a) WATERSHED CLASSIFIED AS MOUNTAINOUS - ROLLING

b) WATERSHED AREA: 0.46 sq. mi *

c) EXTRAPOLATING FROM NED-ACE GUIDE CURVES:

PMF = 2350 CSM

D) PEAK INFLOW

PMF = 2350 (.46) = 1081 CFS USE 1080 C

1/2 PMF = 540 CFS

2) SURCHARGE AT PEAK INFLOWS

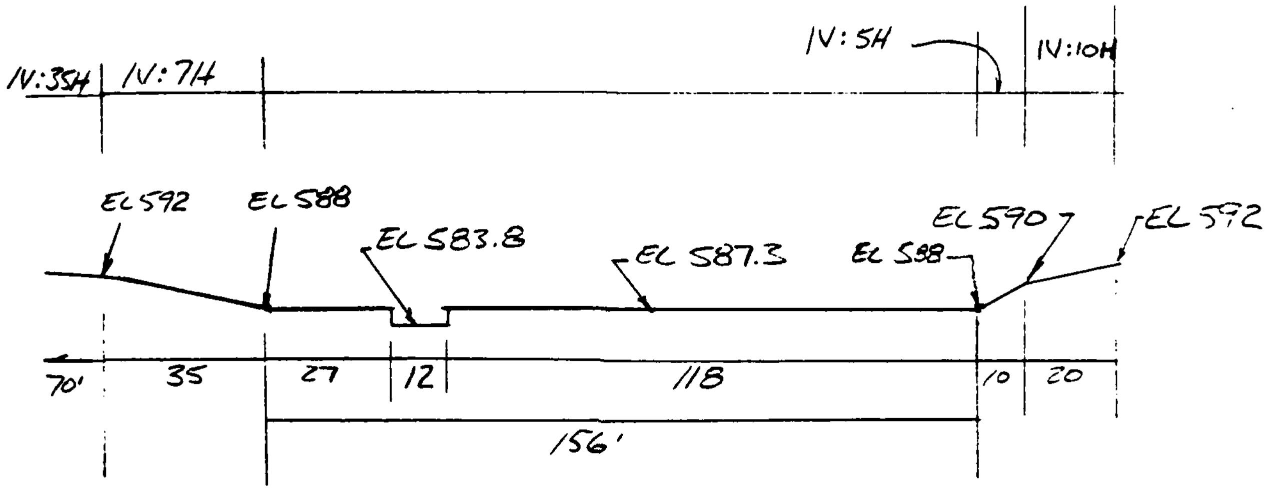
a) OUTFLOW RATING CURVE

i SPILLWAY

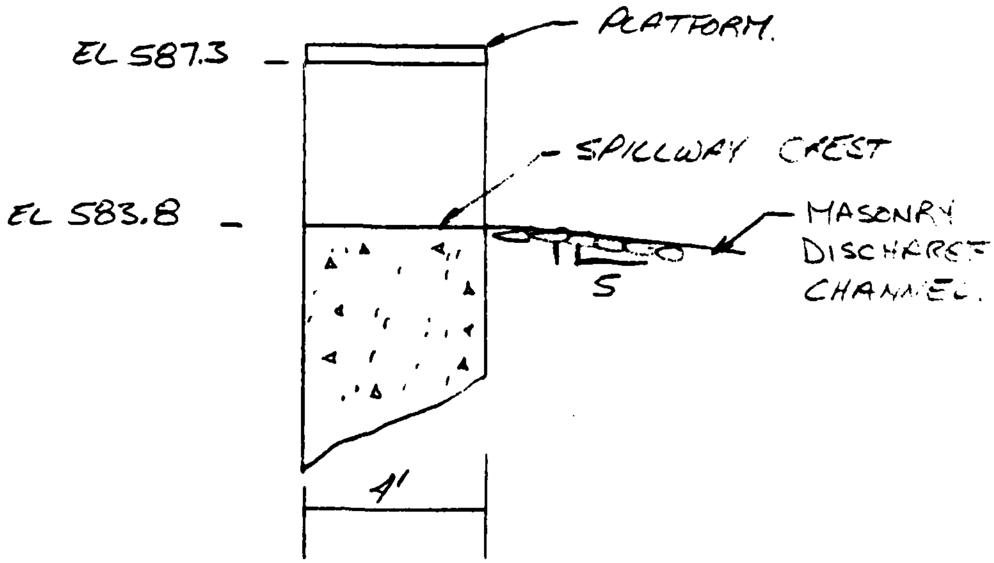
THE LAKE NARANEKA DAM SPILLWAY CONSISTS OF TWO 5.5-FOOT-LONG by 3.5-FOOT-HIGH OPENINGS SEPARATED BY A 1-FOOT-WIDE CONCRETE PIER. THE CREST IS AT EL 583.9 NGVD AND HAS

* DRAINAGE AREA MEASURED FROM PEACH LAKE CT-NY USGS QUADRANGLE MAP.

A CREST WIDTH OF 4 FEET. A PROFILE ALONG THE ℄ OF THE DAM AND A SPILLWAY SECTION ARE PRESENTED BELOW.



PROFILE ALONG ℄ OF DAM
SCALE 1"=40'



SECTION

INTERNATIONAL ENGINEERING COMPANY, INC.

Project NFDT
Feature LAKE NARANEKA DAM
Item
Contract No. 2616
Designed EHR
Checked
Sheet D-4
File No.
Date 7/22/81
Date

ASSUMING A DISCHARGE COEFFICIENT OF C = 3.0 THE SPILLWAY DISCHARGE MAY BE APPROXIMATED BY:

i. $Q_S = CLH^{3/2} = 3.0\,(11)\,H^{3/2} = 33\,H^{3/2}$

ii. EXTENSION OF RATING CURVE FOR SURCHARGE OVERTOPPING DAM AND/OR ADJACENT TERRAIN. DUE TO THE IRREGULARITIES IN THE ADJACENT TERRAIN AN EQUIVALENT WEIR LENGTH MUST BE COMPUTED FOR THE ENTIRE INUNDATED LENGTH OF THE PROFILE. ASSUMING A DISCHARGE COEFFICIENT C = 3.0 FOR FLOW OVER THE CONCRETE DAM ; C = 2.7 FOR FLOW OVER THE ADJACENT TERRAIN AND ADOPTING THE SPILLWAY CREST ELEVATION 583.8 AS DATUM THE OVERFLOW MAY BE APPROXIMATED BY THE FOLLOWING EQUATIONS:

(1) DAM

$Q_D = 3.0\,(145)(H-3.5)^{3/2} = 435\,(H-3.5)^{3/2}\,; \; H \geq 3.5$

(2) RIGHT TERRAIN SLOPE 1V:5H

$$L_{eq} = \tfrac{2}{5}(5)(H)$$

$H \le 6.2'$ $\quad Q_{R_1} = 2.7\left(\tfrac{2}{5}(5)(H-4.2)\right)(H-4.2)^{3/2} = 5.4(H-4.2)^{5/2}$

$H > 6.2'$ $\quad Q_{R_1} = 5.4(H-4.2)^{5/2}\left[1-\left(1-\frac{2}{H-4.2}\right)^{5/2}\right]$

(3) RIGHT TERRAIN SLOPE 1V:10H

$$L_{eq} = \tfrac{2}{5}(10)(H-6.2)$$

$$Q_{R_2} = 2.7\left(\tfrac{2}{5}(10)(H-6.2)\right)(H-6.2)^{3/2}$$

$$Q_{R_2} = 10.8(H-6.2)^{5/2}$$

(4) LEFT TERRAIN SLOPE 1V:7H

$$L_{eq} = \tfrac{2}{5}(7)(H)$$

$H \le 8.2$ $\quad Q_{L_1} = 2.7\left(\tfrac{2}{5}(7)(H-4.2)\right)(H-4.2)^{3/2} = 7.56(H-4.2)^{5/2}$

$H > 8.2$ $\quad Q_{L_1} = 7.56(H-4.2)^{5/2}\left[1-\left(1-\frac{4}{H-4.2}\right)^{5/2}\right]$

(5) LEFT TERRAIN SLOPE 1V:35H

$$L_{eq} = \tfrac{2}{5}(35)(H-8.2)$$

$$Q_{L_2} = 2.7\left(\tfrac{2}{5}(35)(H-8.2)\right)(H-8.2)^{3/2}$$

$$Q_{L_2} = 37.8(H-8.2)^{5/2}$$

INTERNATIONAL ENGINEERING COMPANY, INC.

Project ______ Contract No. 2616 Sheet D-6
Feature LAKE NARANEKA DAM Designed EHB File No. ______
Item ______ Checked ______ Date 7/22/81 Date ______

TOTAL OUTFLOW AT DAM

$$Q_T = Q_S + Q_D + Q_{R_1} + Q_{R_2} + Q_{L_1} + Q_{L_2}$$

$$H \leq 6.2 \quad Q_T = 33 H^{3/2} + 435(H-3.5)^{3/2} + 5.4(H-4.2)^{5/2} + 7.56(H-4.2)^{5/2}$$

$$Q_T = 33 H^{3/2} + 435(H-3.5)^{3/2} + 12.96(H-4.2)^{5/2}$$

$$6.2 < H \leq 8.2 \quad Q_T = 33 H^{3/2} + 435(H-3.5)^{3/2} + 5.4(H-4.2)^{5/2}\left[1-\left(1-\frac{2}{H-4.2}\right)^{5/2}\right] + 10.8(H-6.2)^{5/2} + 7.56(H-4.2)^{5/2}$$

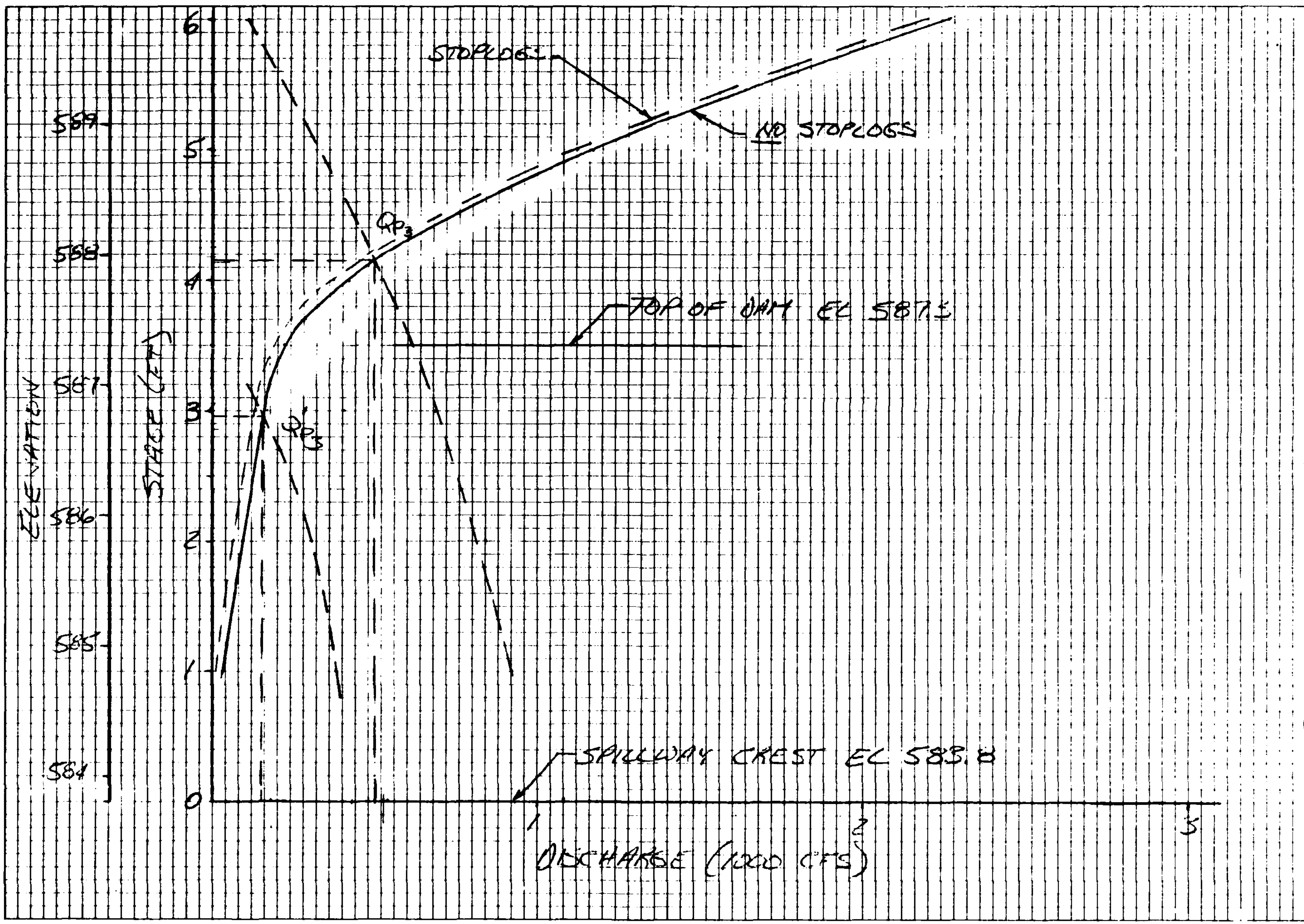
OUTFLOW RATING CURVE (SHEET D-7)

STAGE [FT]	DISCHARGE (CFS)	DISCHARGE WITH FLASHBOARDS (cfs)
1	33	12
3.5	216	171
4	418	370
5	1176	1122
6	2261	2201

b. SURCHARGE HEIGHT TO PASS PEAK INFLOWS

@ PMF = 1080 CFS $H_1 \approx 4.80'$

@ 1/2 PMF = 540 CFS $H_1 \approx 4.25'$


STOPLOGS
NO STOPLOGS
Qp_3
TOP OF DAM EL 587.5
SPILLWAY CREST EL 583.8
ELEVATION
STAGE (FT)
589
588
587
586
585
584
0
1
2
3
4
5
6
DISCHARGE (1000 CFS)

D-7

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-8

Project ______ Contract No. 2616 File No. ______

Feature LAKE ... DAM Designed EHB Date 7/24/81

Item ______ Checked ______ Date ______

b) SURCHARGE HEIGHT TO PASS PEAK INFLOWS (Q_{P_1} ; Q_{P_1}')

i) Q_{P_1} = PMF ≈ 1080 CFS H_1 = 1.80 FT

ii) Q_{P_1}' = ½PMF ≈ 540 CFS H_1' = 1.25 FT

c) EFFECT OF SURCHARGE ON PEAK OUTFLOWS:

i) RESERVOIR SURCHARGE STORAGE FROM MEASUREMENTS FROM USGS 7.5 MINUTE QUAD. (SEE SHEET D-9).

ii) NORMAL POOL ASSUMED AT SPILLWAY CREST

iii) DISCHARGE Q_{P_2} AT VARIOUS HYPOTHETICAL SURFACE ELEVATIONS.

$$H = 6' \quad V = 420\ \text{ac-ft} \ \therefore\ S = \frac{420\ \text{ac-ft}}{.46\left(640\ \text{AC}/\text{mi}^2\right)\left(\frac{1\ \text{FT}}{12\ \text{in}}\right)} = 17.13''$$

H = 4' V = 240 AC-FT ∴ S = 9.79"
H = 3' V = 170 AC-FT ∴ S = 6.93"
H = 2' V = 100 AC-FT ∴ S = 4.08"
H = 1' V = 70 AC-FT ∴ S = 2.86"

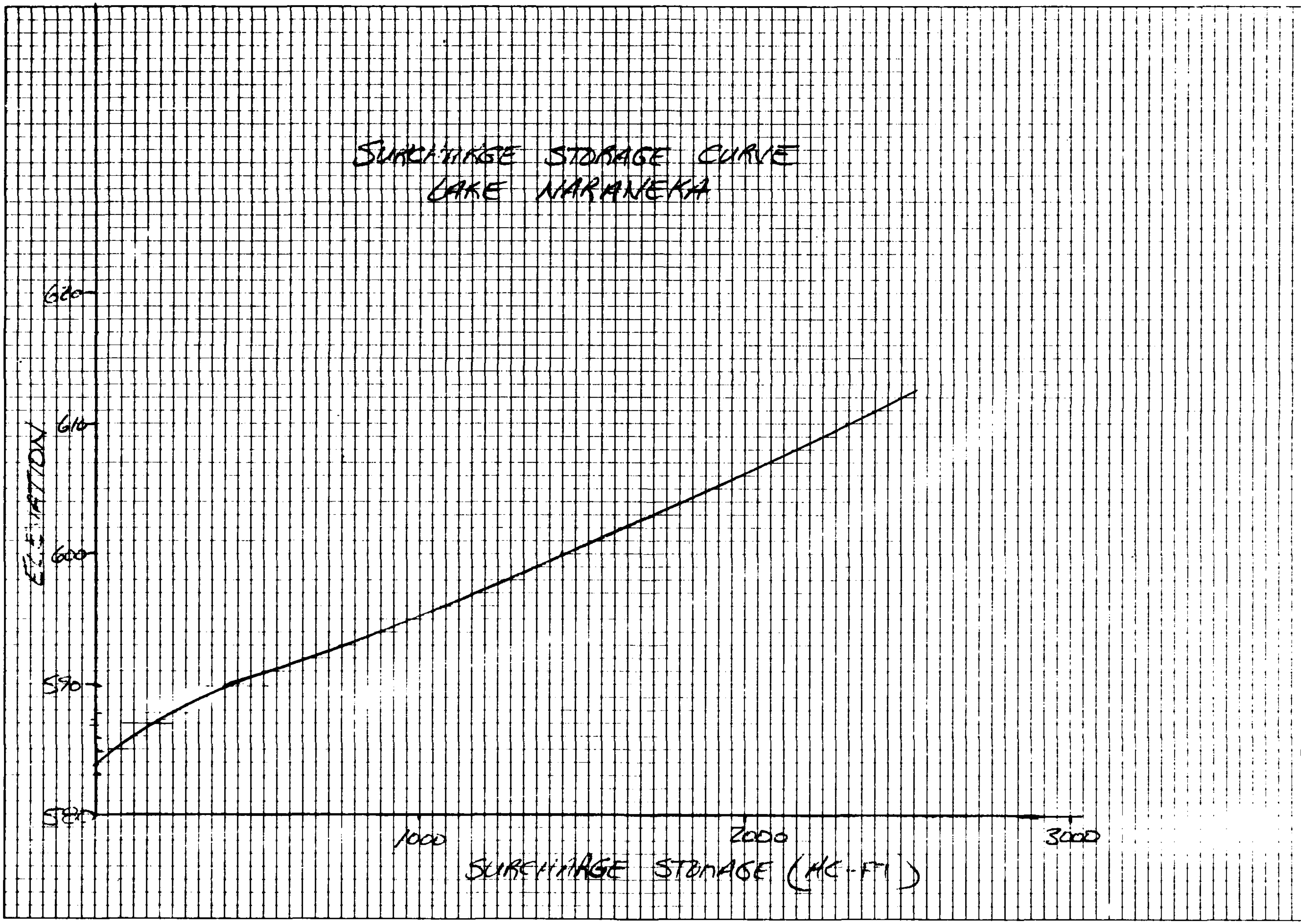
FROM APPROXIMATE ROUTING NED-ACE GUIDELINES AND 19 in MAXIMUM PROBABLE RUNOFF

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{S}{19}\right) \qquad Q_{P_2}' = Q_{P_1}'\left(1 - \frac{S}{9.5}\right)$$

∴ FOR PREVIOUS HYPOTHETICAL SURCHARGE

H = 6 FT Q_{P_2} = 106 CFS ; Q_{P_2}' = –

H = 4 FT Q_{P_2} = 524 CFS ; Q_{P_2}' = –
H = 3 FT Q_{P_2} = 686 CFS ; Q_{P_2}' = 146 CFS
H = 2 FT Q_{P_2} = 848 CFS ; Q_{P_2}' = 308 CFS
H = 1 FT Q_{P_2} = 917 CFS ; Q_{P_2}' = 377 CFS


SURCHARGE STORAGE CURVE
LAKE NARANEKA
ELEVATION
620
610
600
590
580
1000
2000
3000
SURCHARGE STORAGE (AC-FT)

d) PEAK OUTFLOWS (Q_{P_3} AND Q'_{P_3})

USING NED-ACE GUIDELINES "SURCHARGE STORAGE ROUTING" ALTERNATE METHOD AND RATING CURVE (SEE SHEET D-7).

Q_{P_3} = 500 CFS ; H_3 = 4.15 FT

Q'_{P_3} = 150 CFS ; H'_3 = 2.95 FT

3) SPILLWAY CAPACITY RATIO TO PEAK INFLOWS AND OUTFLOWS.

a) SPILLWAY CAPACITY TO TOP OF DAM EL 587.3 (No stoplogs)

H = 3.5 FT Q_S = 216 CFS

∴ THE TOTAL SPILLWAY CAPACITY TO TOP OF DAM IS 20%± OF THE INFLOW (Q_{P_1}) AND 43%± OF THE OUTFLOW (Q_{P_3}) AT PEAK FLOOD = PMF.

LIKEWISE, THE TOTAL SPILLWAY CAPACITY TO TOP OF DAM IS 40%± OF THE INFLOW (Q'_{P_1}) AND 144%± OF THE OUTFLOW (Q'_{P_3}) AT THE PEAK FLOOD = ½PMF.

b) SPILLWAY CAPACITY TO PMF AND ½PMF SURCHARGES :

i) SPILLWAY CAPACITY TO PMF SURCHARGE

$H = 4.15 \qquad Q_S \approx 279$ CFS.

∴ THE TOTAL SPILLWAY CAPACITY TO PMF SURCHARGE IS 26%± OF THE INFLOW (Q_{P_1}) AND 56%± OF THE OUTFLOW (Q_{P_3}).

ii) SPILLWAY CAPACITY TO ½ PMF SURCHARGE

$H = 2.95$ FT $\qquad Q_S \doteq 167$ CFS

∴ THE TOTAL SPILLWAY CAPACITY TO ½ PMF SURCHARGE IS 31%± OF THE INFLOW (Q'_{P_1}) AND 111% OF THE OUTFLOW (Q'_{P_3}).

INTERNATIONAL ENGINEERING COMPANY, INC.

Project ______ Contract No. 2616 Sheet D-12
Feature LAKE NARANEKA UNIT File No. ______
Item ______ Designed EHP Date 7/23/81
Checked ______ Date ______

II DOWNSTREAM FAILURE HAZARD

1) POTENTIAL IMPACT AREA

THE POTENTIAL IMPACT AREA IS LOCATED APPROXIMATELY 0.4 MILES DOWNSTREAM OF THE DAM. TWO HOMES HAVE FIRST FLOOR ELEVATIONS 3-5 FEET ABOVE STREAM LEVEL. THE HOMES ARE ADJACENT TO SMALL PONDS WHICH ARE SEPARATED BY A DAM (SEE FLOOD PLANE MAP SHEET D-1A).

2) FAILURE AT LAKE NARANEKA DAM

a) BREACH WIDTH

i. HEIGHT OF DAM

TOP OF DAM EL 587.3
STREAMBED @ LOW LEVEL OUTLET INVERT EL 569.6

∴ HEIGHT OF DAM = 17.7 FT

ii. MID HEIGHT OF DAM EL 578.5

iii. APPROXIMATE MID HEIGHT LENGTH ℓ = 97'

iv BREACH WIDTH (SEE NED-ACE FAILURE GUIDELINES) $W_b = 0.4\,(97) = 38.8'$

INTERNATIONAL ENGINEERING COMPANY, INC.

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Feature LAKE NARAMEKA DAM Designed EHR File No. ______
Item ______ Checked B Date 7/22/81
Date ______

b) PEAK FAILURE OUTFLOW (Q_p)

ASSUME SURCHARGE AT TOP OF DAM EL 583.8

i. HEIGHT AT TIME OF FAILURE $Y_0 = 17.7$ FT

ii. SPILLWAY DISCHARGE AT TIME OF FAILURE

$$Q_s = 216 \text{ CFS}^{*}$$

*NOTE: SPILLWAY NOT INCLUDED IN BREACHED SECTION OF DAM.

iii. BREACH OUTFLOW (Q_b)

$$Q_b = 8/27 \, W_b \sqrt{g} \; Y_0^{3/2}$$

$$Q_b = 8/27 (38.8) \sqrt{32.2} \; (17.7)^{3/2}$$ USE 4860 CFS

iv PEAK FAILURE OUTFLOW TO KIAHAE BROOK

$$Q_{P_1} = Q_s + Q_b = 4860 + 216 = \underline{5080} \text{ CFS}$$

c. FLOOD DEPTH IMMEDIATELY DOWNSTREAM OF DAM

$$Y = 0.44 \, Y_0 = 0.44 (17.7) = 7.8'$$

d) ESTIMATE OF D/S FAILURE CONDITIONS AT POTENTIAL IMPACT AREA:

THE PEAK FAILURE OUTFLOW WAS ROUTED THROUGH REACHES OF CHANNEL (SEE PROFILE, SHEET D-25); THE COMPUTATIONS AND STAGE-DISCHARGE, STORAGE-DISCHARGE CURVES APPEAR ON SHEETS D-27

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-14
Project ______ Contract No. 2616 File No. ______
Feature LAKE MAHANEKA DAM Designed EHP Date 7/23/[illegible]
Item ______ Checked [illegible] Date ______

THROUGH D-47. ATTENUATION OF THE PEAK FAILURE OUTFLOW ARISING FROM CHANNEL NET STORAGE WAS COMPUTED BY SUBTRACTING OUT STORAGE ABSTRACTED BY THE CHANNEL FROM THE VOLUME UNDER THE DAM BREACH HYDROGRAPH AT FAILURE. THE RESULTS OF THE ANALYSIS ARE:

ROUTING OF LAKE MAHANEKA DAM PEAK FAILURE OUTFLOW:

$S = 677$ AC-FT

REACH A: (FROM A to A1)

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{V}{S}\right)$$

WHERE V = CHANNEL STORAGE ABOVE PREFAILURE OUTFLOW LEVEL. OUTFLOW VOLUME $\Delta V_1 = 0.1$ AC-FT @ 216 CFS (SEE SHEET D-47

$$\therefore \quad Q_{P_2} = Q_{P_1}\left(1 - \left(\frac{V - \Delta V_1}{S}\right)\right)$$

$$Q_{P_2} = 5080\left(1 - \left(\frac{V - .1}{677}\right)\right)$$

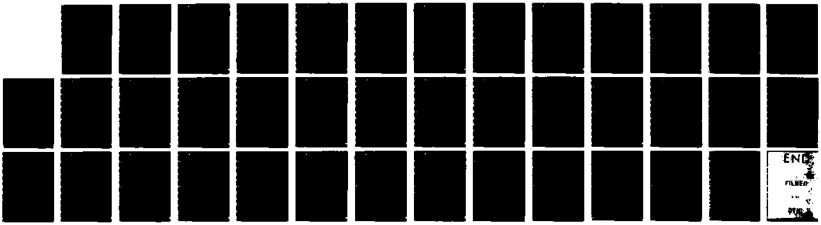
Q_{P_1}	V	Q_{P_2}
5080	.5	5077
5080	1	5073
5080	1.5	5069
5080	2.0	5066

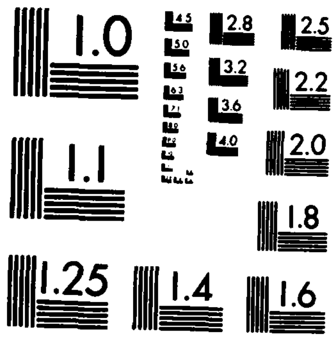
STORAGE IN REACH A1-A = V_A = 1.3 AC-FT
OUTFLOW Q_{P_3} = 5074 CFS (SEE D-15)
NET ABSTRACTED = 1.3 - 0.1 = 1.2 AC-FT

AD-A143 344 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS LAKE NARANEKA DAM (CT..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV AUG 81

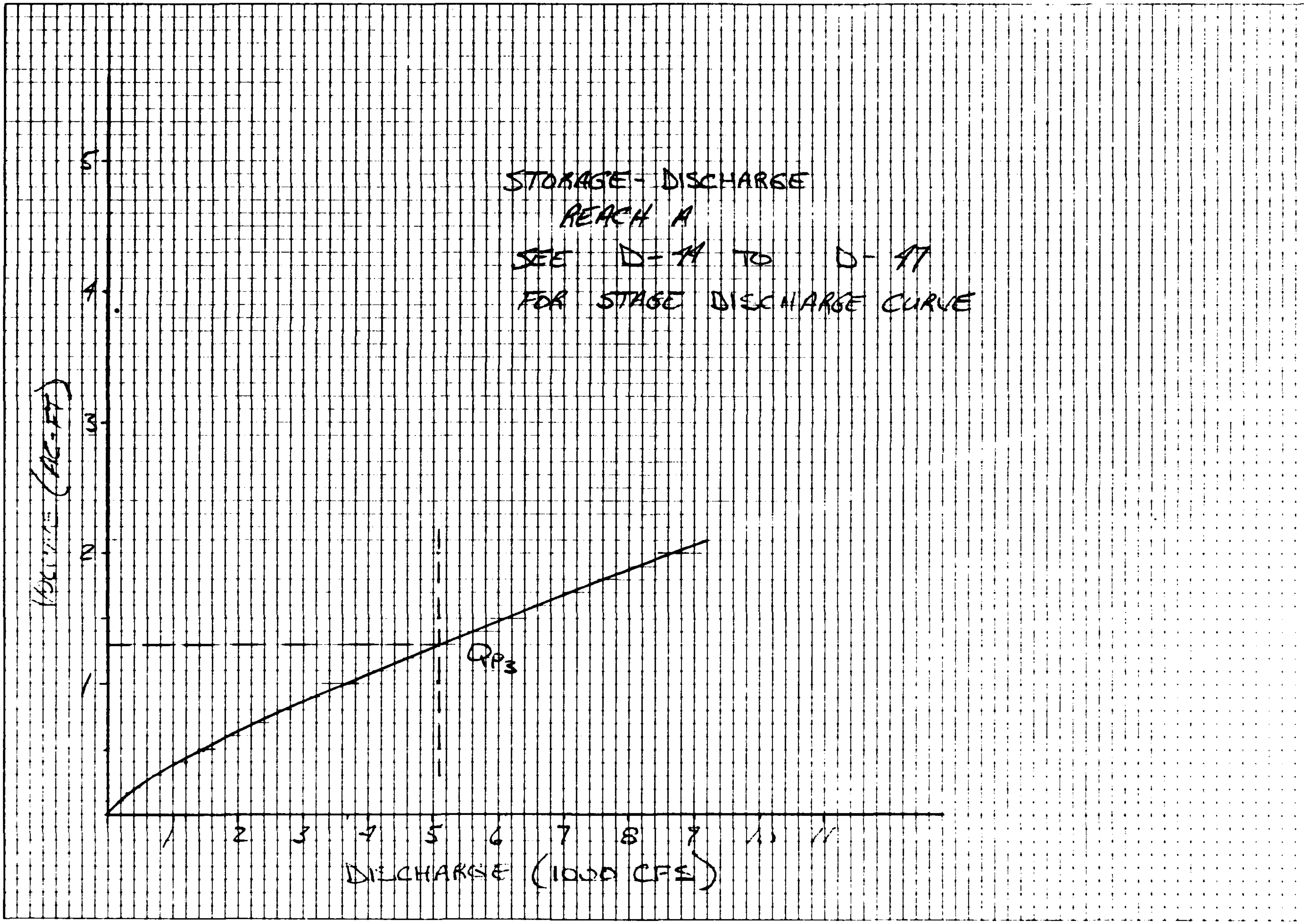
2/2

UNCLASSIFIED F/G 13/13 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A


STORAGE - DISCHARGE
REACH A
SEE D-14 TO D-17
FOR STAGE DISCHARGE CURVE
Q_{P3}
DISCHARGE (1000 CFS)
(AC-FT)
1
2
3
4
5
6
7
8

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-16
Project
Contract No. 2616
File No.
Feature LAKE MIRAMEKA DAM
Designed EJK
Date 7/23/81
Item
Checked Q
Date

REACH B:

REACH FROM SECTION "A" TO EARLOW MOUNTAIN ROAD.

$Q_{P_1} = 5074\ CFS \quad V_A = 1.3\ AC\text{-}FT \quad V_{A_{NET}} = 1.2\ AC\text{-}FT$

$\Delta V_1 = .1\ AC\text{-}FT$ (@ 216 CFS SEE D-43)

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{V - \Delta V_1}{S - V_A}\right)$$

$$Q_{P_2} = 5074\left(1 - \frac{(V - .1)}{(677 - 1.2)}\right)$$

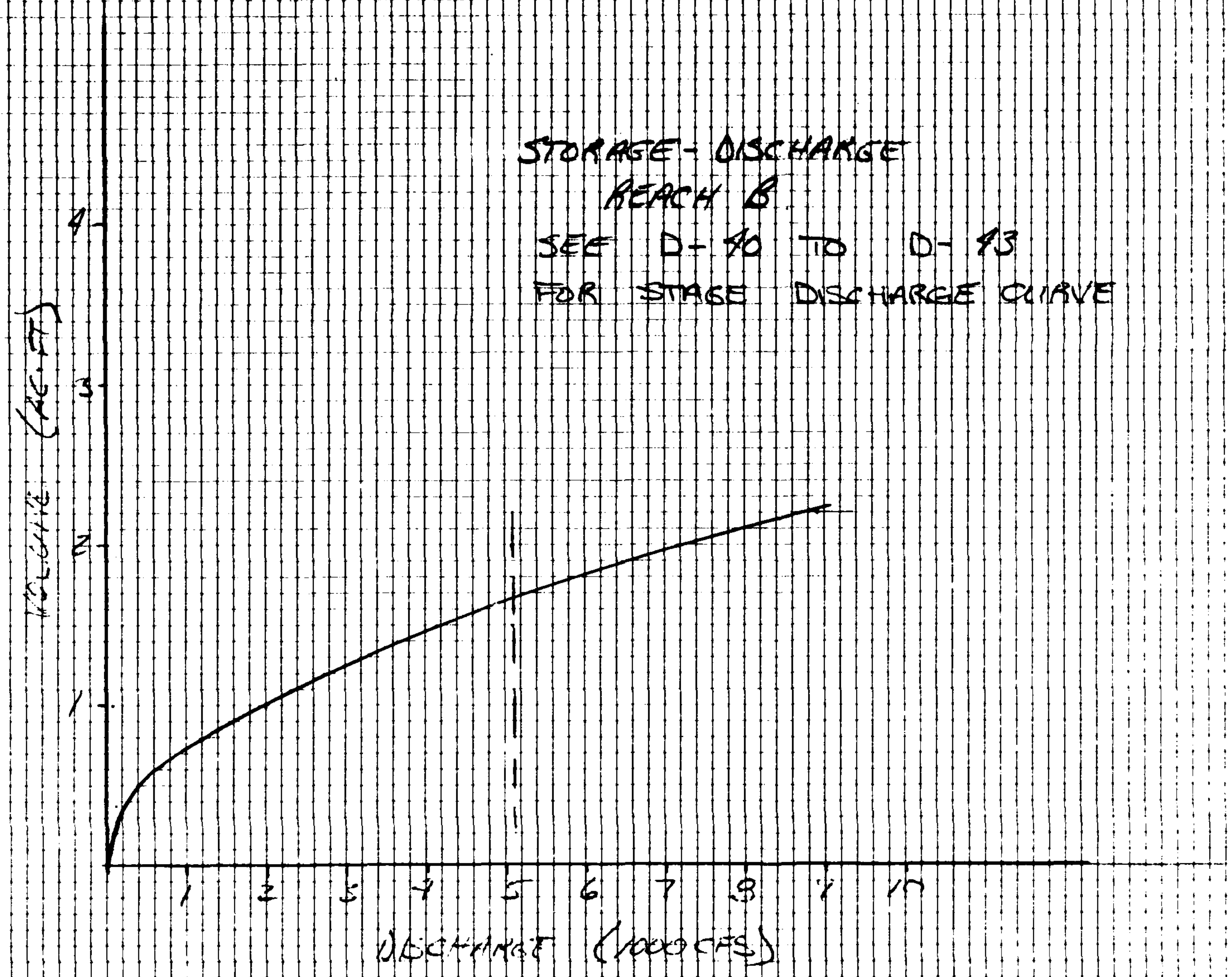
Q_{P_1}	V	Q_{P_2}
5074	.5	5071
5074	1.0	5067
5074	1.5	5063
5074	2.0	5060

FROM VOLUME DISCHARGE CURVE SHEET D-17

$Q_{P_3} = 5063\ CFS$

$V_B = 1.65\ AC\text{-}FT$

NET ABSTRACTED $1.65 - 0.1 = \underline{1.55}\ AC\text{-}FT$


STORAGE - DISCHARGE
REACH B
SEE D-40 TO D-43
FOR STAGE DISCHARGE CURVE
VOLUME (AC-FT)
1
2
3
4
1
2
3
4
5
6
7
8
9
10
DISCHARGE (1000 CFS)

REACH C:

ROUTING BARLOW MOUNTAIN ROAD TO SECTION E

PREVIOUS CHANNEL STORAGE $V_A + V_B = 1.2 + 1.55 = 2.75$ AC-FT.

SPILLWAY DISCHARGE STORAGE $\Delta V_1 = 0.1$ AC-FT @ 216 CFS

(SEE SHEET D-3)

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{V - \Delta V_1}{S - V_A - V_B}\right)$$

$$Q_{P_2} = 5063\left(1 - \frac{V - 0.1}{677 - 2.75}\right)$$

Q_{P_1}	V	Q_{P_2}
5063	.5	5060
5063	1.0	5056
5063	1.5	5052
5063	2.0	5049
	4.0	5034
	6.0	5019
	10.0	4989

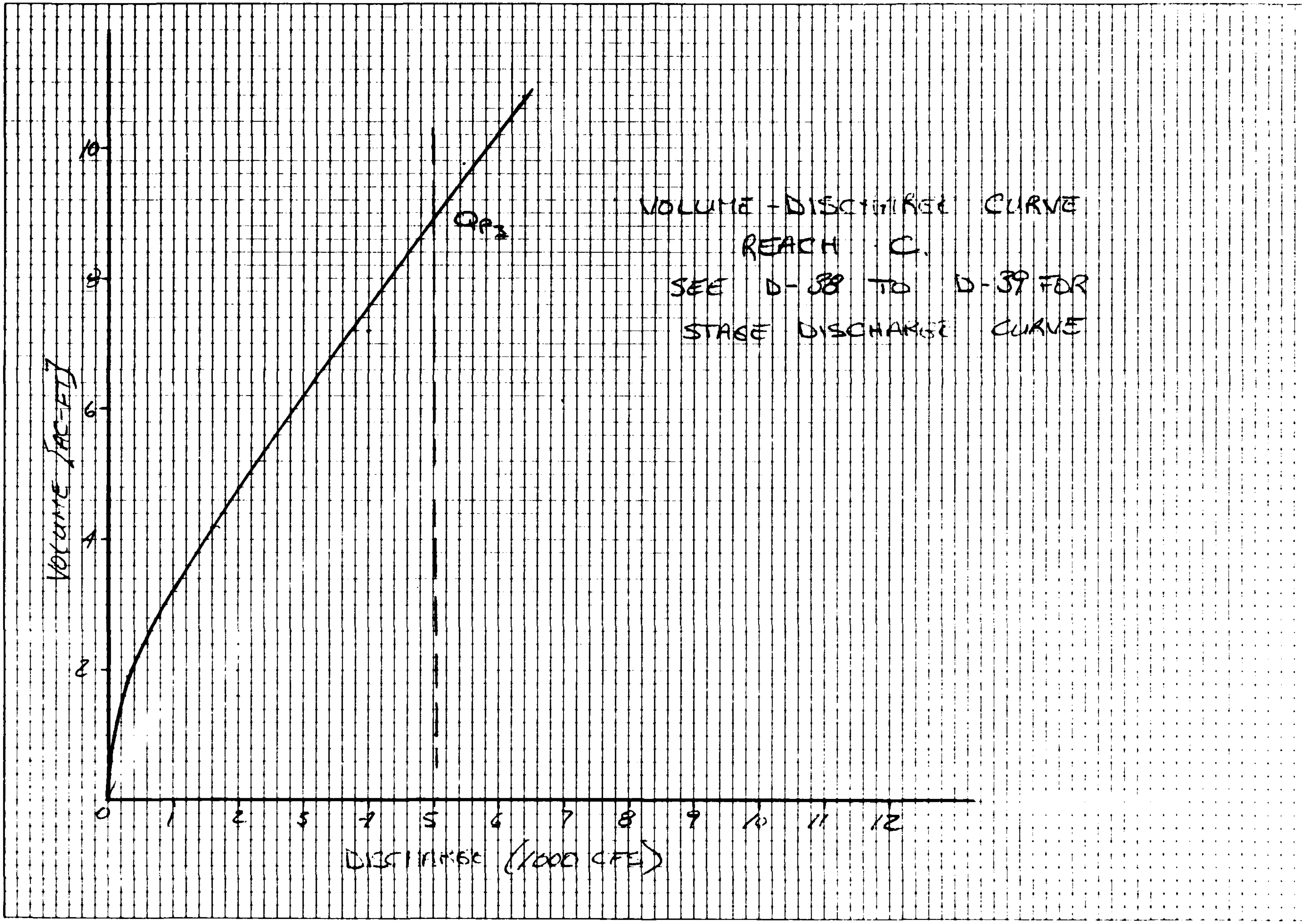
$Q_{P_3} =$ 5000 CFS (SEE D-19)

$V_C = 8.8$ AC-FT

NET ABSTRACTED $8.8 - 0.1 = 8.7$ AC-FT

K•E 10 X 10 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO MADE IN U.S.A.

46 0660



INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-20

Project ______ Contract No. 2616 File No. ______

Feature LAKE NARRANERA DAM Designed EHR Date 7/22/81

Item ______ Checked ______ Date ______

REACH E:

ROUTING FROM E TO SMALL DAM

PREVIOUS CHANNEL STORAGE $V_A + V_B + V_C$

$1.2 + 1.55 + 8.7 = 11.45$ AC-FT.

SPILLWAY DISCHARGE - $10.1 - 5.5 = 4.6$ AC-FT *

$Q_{P_1} = 5000$ CFS.

$$Q_{P_2} = 5000\left(1 - \frac{V - 4.6}{(677 - 11.45)}\right)$$

Q_{P_2}	V
4884	20
4734	40
4584	60

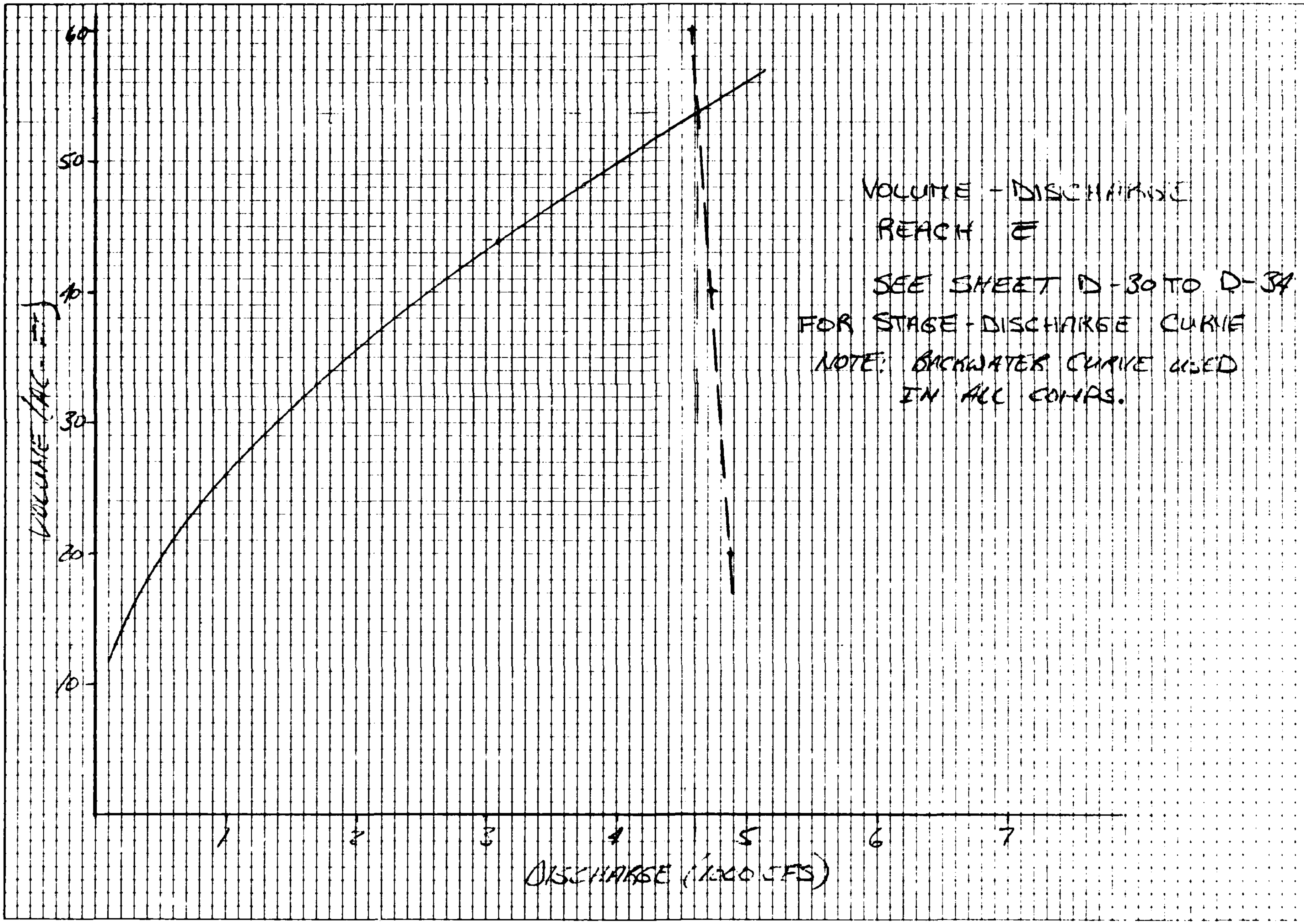
$Q_{P_3} = 4600$ CFS. (SEE D-21)

$V_E = 53.5$ AC-FT

NET ABSTRACTED $= 53.5 - 4.6 = 48.9$ AC-FT

* ASSUME POND IN REACH E IS FULL (IE TOP OF DAM EL 516) STORAGE = 5.5 AC-FT FURTHER MORE PREFAILURE DISHARGE (216 CFS) WILL CAUSE WATER TO OVER TOP DAM ∴ TOTAL STORAGE AT OVERTOPPING (EL 518.2) IS 10.1 AC-FT ∴ 10.1 - 5.5 = 4.6 AC-FT; OR THE VOLUME OCCUPIED BY THE PREFAILURE OUTFLOW. (SEE POND STORAGE D-48)

NOTE : DAM ASSUMED INTACT THROUGHOUT BREACH ROUTING.


VOLUME - DISCHARGE
REACH E
SEE SHEET D-30 TO D-34
FOR STAGE-DISCHARGE CURVE
NOTE: BACKWATER CURVE USED
IN ALL COMPS.
60
50
40
30
20
10
1
2
3
4
5
6
7
DISCHARGE (1000 CFS)

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-22

Project ______ Contract No. 2616 File No. ______

Feature LAKE NIMPANEKA DAM Designed ______ Date ______

Item ______ Checked ______ Date ______

KIAHAS REACH:

ROUTING FROM DAM TO KIAHAS BROOK LANE

$Q_{P_1} = 4550$ CFS

PREVIOUS CHANNEL STORAGE $q_A + q_B + q_C + q_E$

$1.2 + 1.55 + 8.7 + 48.9 = 60.35$ AC-FT

SPILLWAY DISCHARGE = $14 - 1.2 = 12.8$ AC-FT *

$$Q_{P_2} = 4600\left(1 - \frac{(V - 12.8)}{(677 - 60.35)}\right)$$

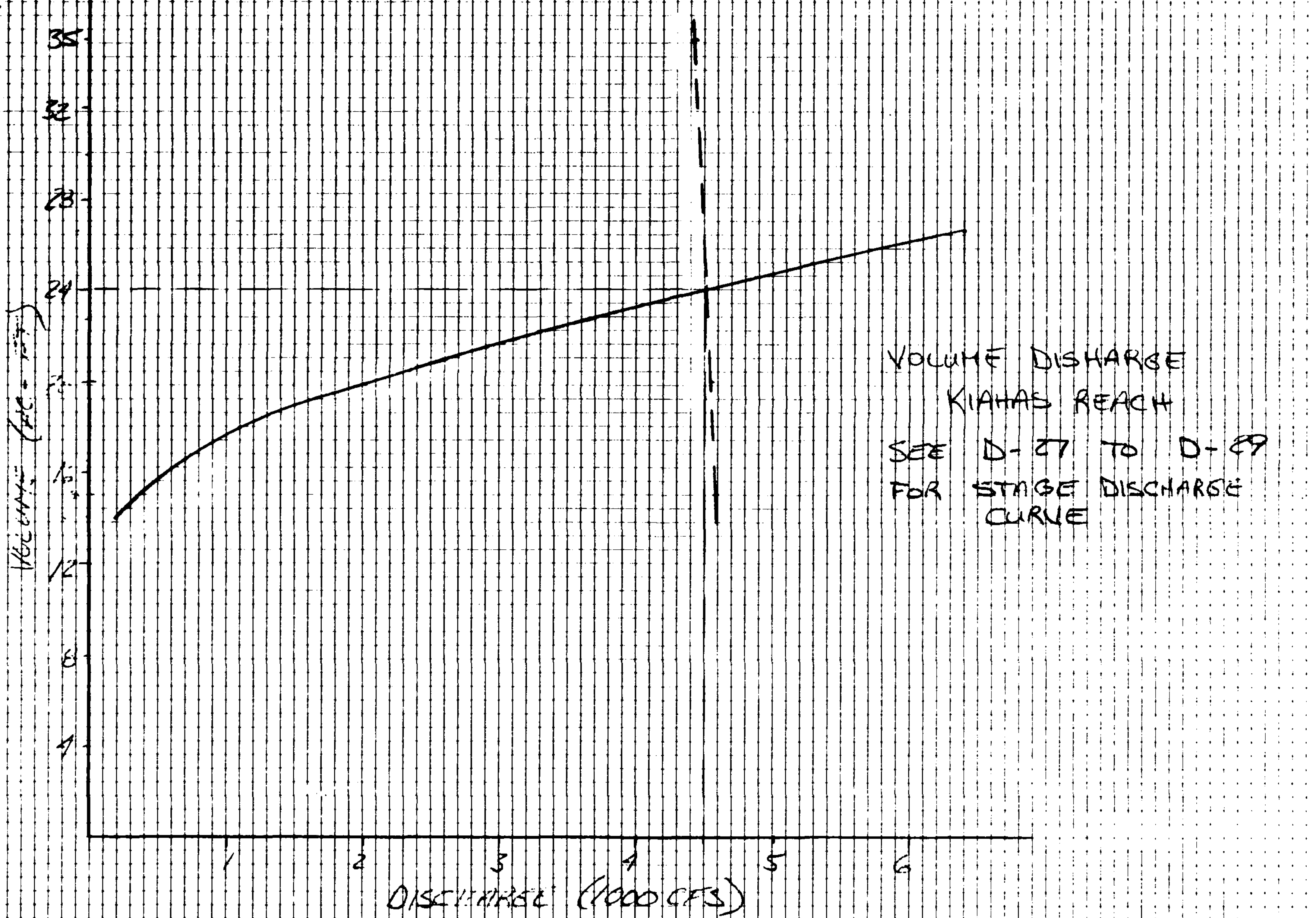
V	Q_{P_2}
15	4584
20	4546
35	4434

$Q_{P_3} = 4500$ CFS

$V_{KIAHAS} = 24.0$ ACRE-FEET.

NET ABSTRACTED $24 - 12.8 = 11.2$ AC-FT

* ASSUME POND AT EL 538 (STORAGE 1.2 AC-FT) SPILLWAY DISCHAGE RAISES STAGE TO EL. 547 (TOTAL STORAGE = 14 AC-FT) ∴ STORAGE OCCUPIED BY PREFAILURE OUTFLOW (216 CFS) IS $14 - 1.2 = 12.8$ AC-FT. (SEE POND STORAGE CURVE D-49)


VOLUME DISHARGE
KIAHAS REACH
SEE D-27 TO D-29
FOR STAGE DISCHARGE
CURVE
35
32
28
24
12
8
4
1
2
3
4
5
6
DISCHARGE (1000 CFS)

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-24

Project ____ Contract No. 2616 File No. ____

Feature LAKE NARANEKH DAM Designed EHR Date 7/27/9_

Item ____ Checked ____ Date ____

SUMMARY OF FLOWS IN D/S CHANNEL

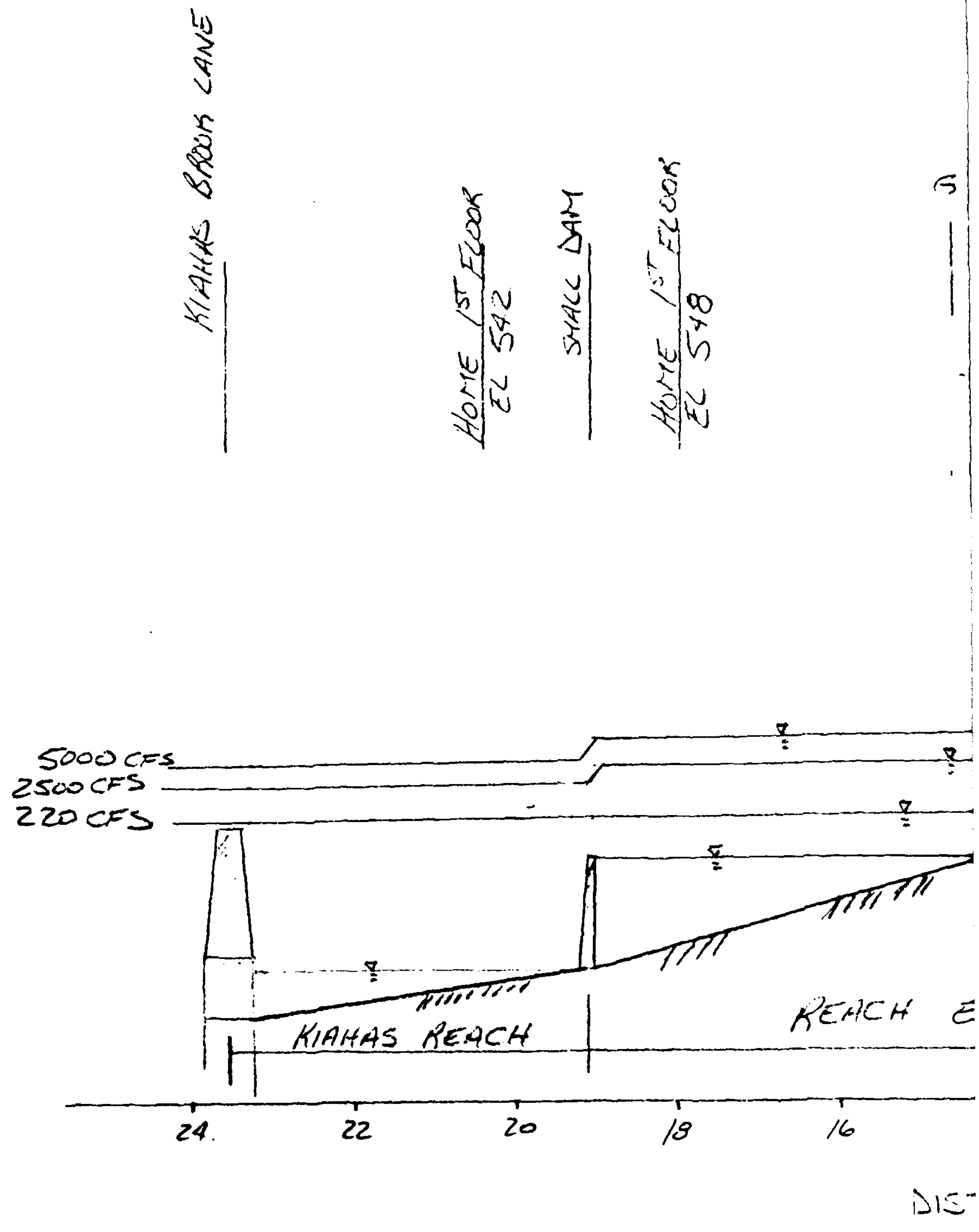
REACH	PEAK INFLOW	PEAK OUTFLOW	STORAGE (TOTAL) (AC-FT)
A	5080	5074	1.3
B	5074	5063	1.65
C	5063	5000	8.8
E	5000	4600	53.5
KIAHAS	4600	4500	24.0

SUMMARY OF DAM BREACH STAGES ABOVE STREAM BED

REACH	INITIAL	FINAL	Δ
A	1.6	6.7	5.1
B	5.1	8.6	3.5
C	.45	3.3	2.85
E	2.3*	6.9*	4.6
KIAHAS	12.0	15.4	3.4

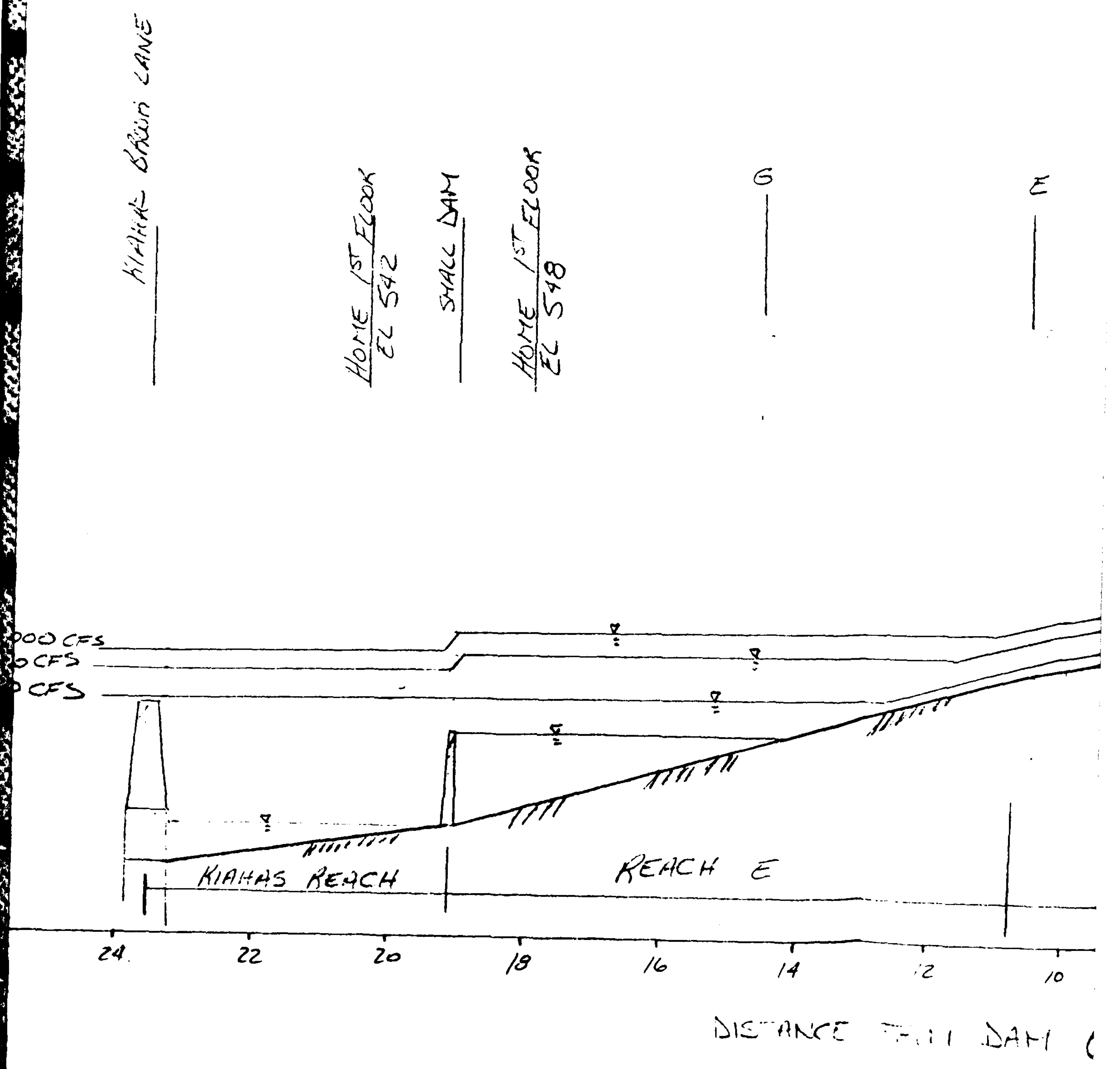
* ABOVE D/S DAM CREST EL 546

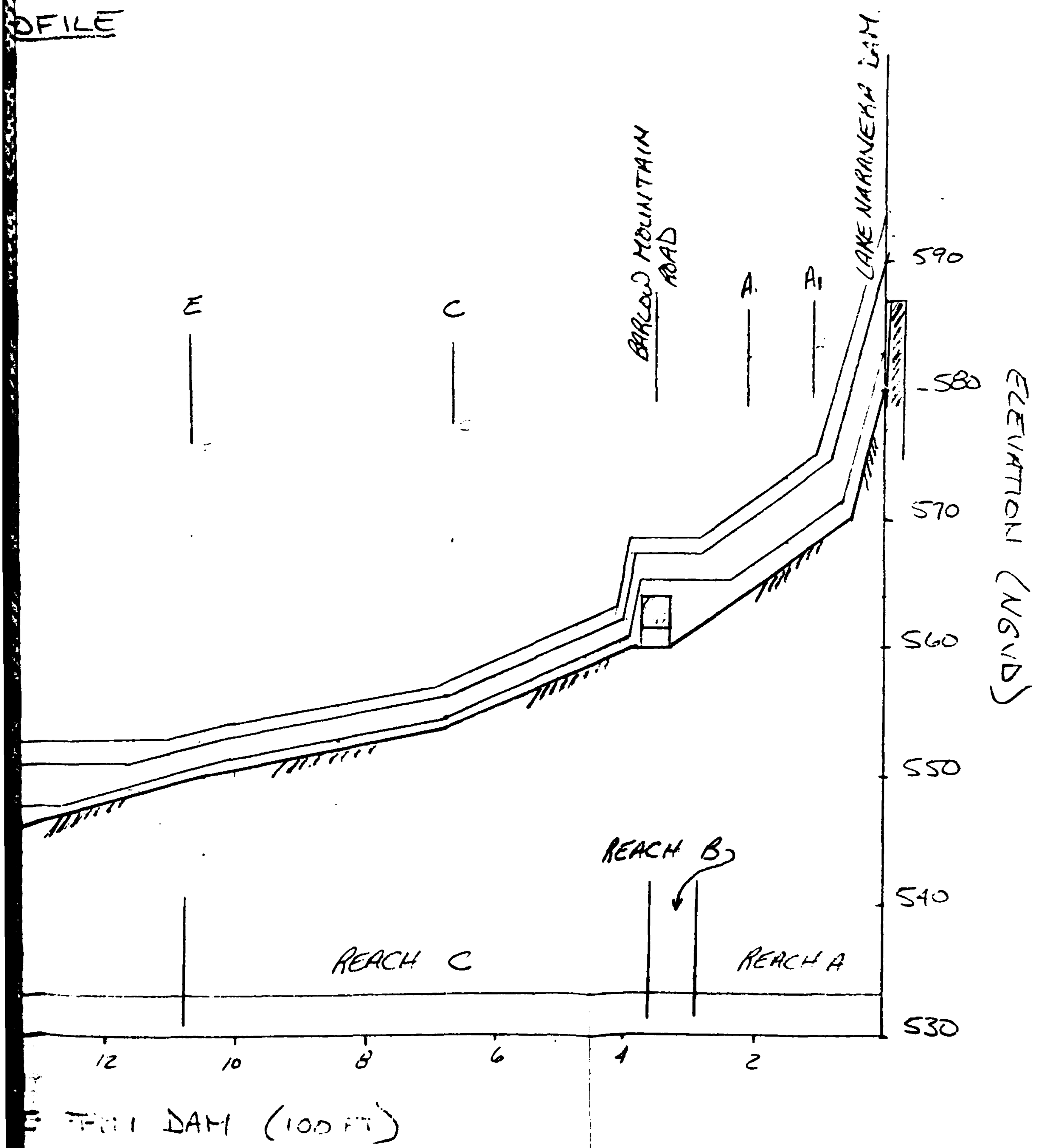
CHANNEL



KIAHAS BROOK LANE
HOME 1ST FLOOR
EL 542
SMALL DAM
HOME 1ST FLOOR
EL 548
5000 CFS
2500 CFS
220 CFS
KIAHAS REACH
REACH E
24
22
20
18
16
DIST

CHANNEL PROFILE





OFILE
LAKE NARANEKA DAM
BARLOW MOUNTAIN ROAD
E
C
A.
A1
590
580
570
560
550
540
530
ELEVATION (NGVD)
REACH B
REACH C
REACH A
12
10
8
6
4
2
DAM (100 FT)

III SELECTION OF TEST FLOOD

1) CLASSIFICATION ACCORDING TO NED-ACE

a) SIZE: STORAGE (TOP OF DAM) = 677 AC-FT

HEIGHT = 17.7 FT

∴ SIZE IS SMALL

b) HAZARD POTENTIAL: BASED ON D/S FAILURE ANALYSIS AT POTENTIAL IMPACT AREA NO PREFAILURE DAMAGE WILL OCCUR. FAILURE OF LAKE NARANEKA DAM WILL FLOOD THE 1ST D/S HOME TO A DEPTH OF APPROXIMATELY 1.9 FEET AND THE 2nd HOME TO 7.4 FEET.

∴ HIGH HAZARD CLASSIFICATION.

2) TEST FLOOD: PMF

KIAHAS BROOK LANE CULVERT

i CULVERT DISCHARGE (ORIFICE) DIA = 4'

$$Q_C = .6A\sqrt{2gh} = .6(12.57)\sqrt{2(32.2)h}$$

ii. ROAD OVERFLOW : $C = 2.7$ $Q = CLH^{3/2}$

LEVEL SECTION $Q_1 = 2.7(250)(H)^{3/2} = \underline{675H^{3/2}}$

RIGHT TERRAIN :

$$L_{eq} = 2/5(5.5)H$$

$$Q_R = 2.7\left[2/5(5.5)(H)\right]H^{3/2} = \underline{5.94H^{5/2}}$$

LEFT TERRAIN.

$$L_{eq} = 2/5(40)(H)$$

$$Q_L = 2.7\left[2/5(40)(H)\right]H^{3/2} = 43.2H^{5/2}$$

TOTAL OUTFLOW : $Q_T = Q_C + Q_1 + Q_R + Q_L$

$$Q_T = 7.54\sqrt{64.4h} + 675H^{3/2} + 5.94H^{5/2} + 43.2H^{5/2}$$

$$Q_T = 7.54\sqrt{64.4h} + 675H^{3/2} + 49.14H^{5/2}$$

h ~ MEASURED TO ℄ OF CULVERT

H ~ MEASURED FROM TOP OF ROAD

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-2[illegible]

Project ____ Contract No. ____ File No. ____

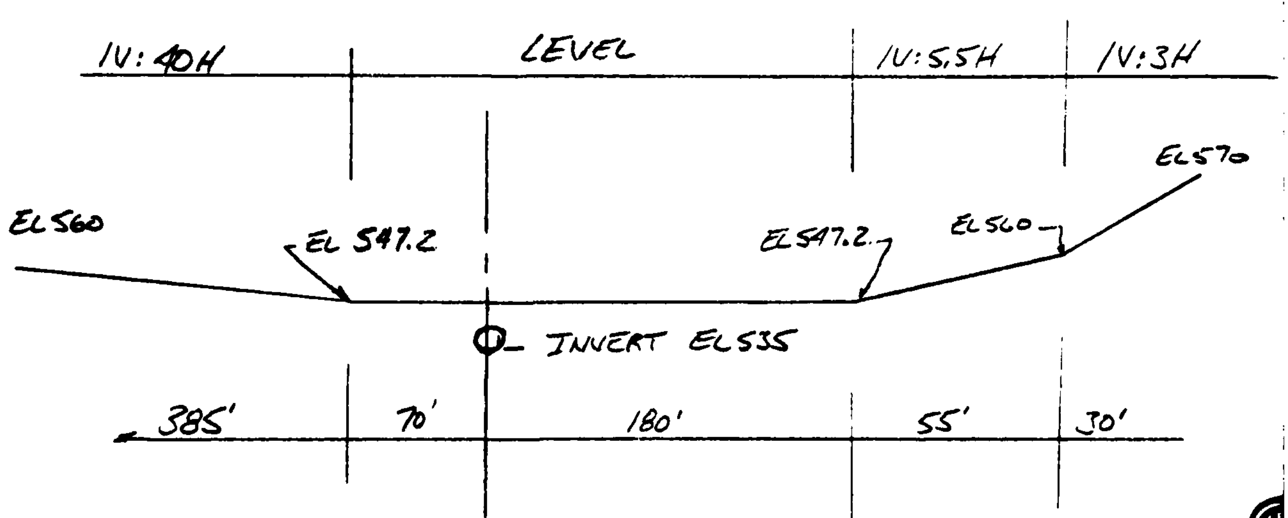
Feature LAKE [illegible] DAM Designed [illegible] Date [illegible]

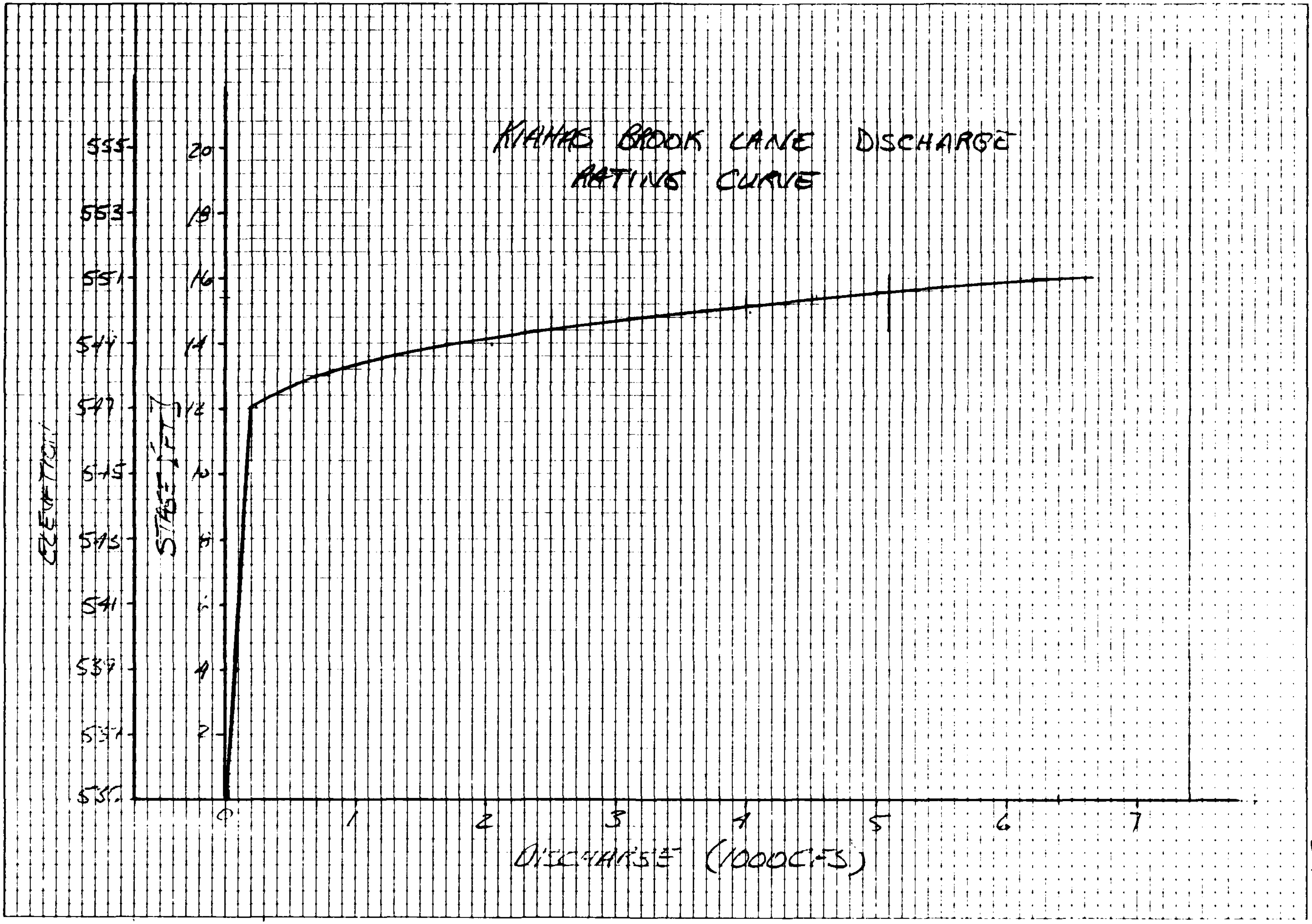
Item ____ Checked [illegible] Date ____

OUTFLOW RATING CURVE

CULVERT INVERT EL 535 ℄ EL 537
TOP OF ROAD EL. 547.2

	ELEVATION	DISCHARGE [CFS]
	539	85.6
	545	171.1
	547.2	193.2
.8	548	711.8
1.8	549	2053
2.8	550	4025
3.8	551	6609
4.8	552	9813



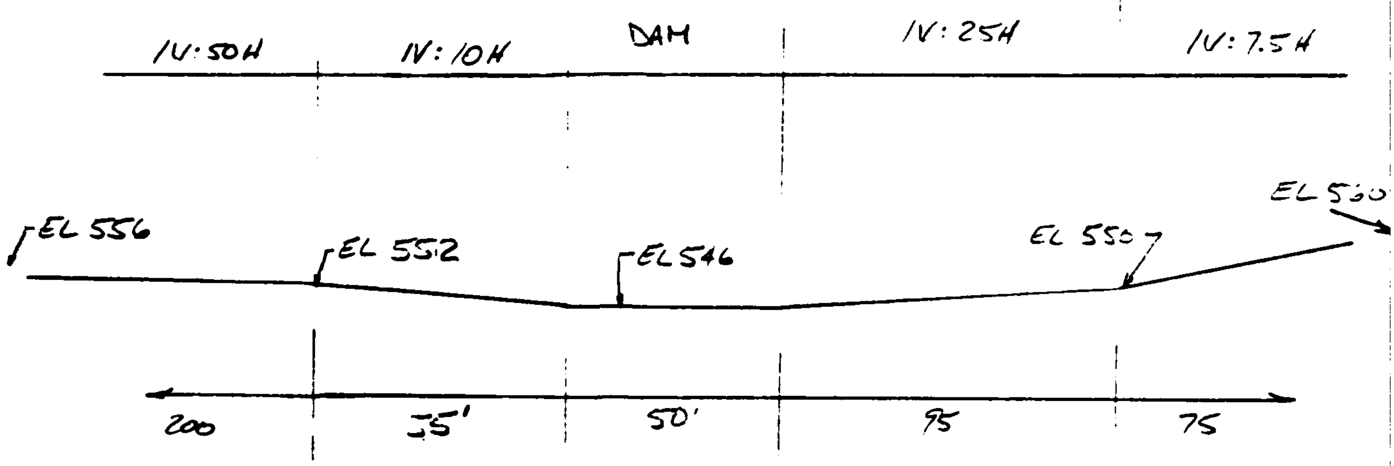

KIAHAS BROOK CANE DISCHARGE
RATING CURVE
ELEVATION
STAGE (FT)
555
553
551
549
547
545
543
541
539
537
535
20
18
16
14
12
10
8
4
2
0
1
2
3
4
5
6
7
DISCHARGE (1000CFS)

INTERNATIONAL ENGINEERING COMPANY, INC.

Project	Contract No.	Sheet D-30
Feature LAKE NARANEKA DAM	Designed EAB	File No.
Item D/S DAM	Checked	Date 7/22/81
		Date

REACH E

DISCHARGE RATING CURVE:



PROFILE ALONG ℄ D/S DAM

* SPILLWAY CREST IS DATUM FOR H VALUES *

i DAM OVERFLOW ASSUME $C = 3.2$

$$Q_D = CLH^{3/2} = 3.2(50)H^{3/2} = \underline{\underline{160}}\ H^{3/2}$$

ii. OVERFLOW LEFT TERRAIN. $C = 2.7$

SLOPE 1V: 10H $L_{eq} = 2/5(10)(H)$

$$Q = 2.7(2/5(10)(H))H^{3/2} = \underline{\underline{10.8H}}^{5/2}\ ;\ H \leq 6$$

$$Q = 2.7(2/5(10)(H^{5/2})\left[1 - \left(1 - \frac{6}{H}\right)^{5/2}\right]\ ;\ H > 6$$

SLOPE 1V: 50H $L_{eq} = 2/5(50)(H-6)$

$$Q = 2.7(2/5(50)(H-6))(H-6)^{3/2} = 54(H-6)^{5/2}$$

iii. OVERFLOW RIGHT TERRAIN

SLOPE 1V:25H $L_{eq} = 2/5(25)(H)$

$$Q = 2.7(2/5(25)(H))H^{3/2} = 27H^{5/2}\ ;\ H \leq 4$$

$$Q = 2.7(2/5(25)(H^{5/2})\left[1 - \left(1 - \frac{4}{H}\right)^{5/2}\right]\ ;\ H > 4$$

SLOPE 1V:7.5H $\ell_{eq} = 2/5(7.5)(H-4)$

$$Q = 2.7\left(2/5(7.5)(H-4)\right)(H-4)^{3/2} = 8.1(H-4)^{5/2}$$

TOTAL DISCHARGE $Q_T = Q_D + Q_L + Q_R$

$$Q_T = 160H^{3/2} + 10.8H^{5/2} + 54(H-6)^{5/2} + 27H^{5/2} + 8.1(H-4$$

$$H \le 4;\ Q_T = 160H^{3/2} + 37.8H^{5/2} + 54(H-6)^{5/2} + 8.1(H-4)^{5/2}$$

$$6 \ge H > 4;\ Q_T = 160H^{3/2} + 10.8H^{5/2} + 54(H-6)^{5/2} + 27H^{5/2}\left[1-\left(1-\frac{4}{H}\right)^{5/2}\right] + 8.1(H-4)^{5/2}$$

$$H > 6;\ Q_T = 160H^{3/2} + 10.8H^{5/2}\left[1-\left(1-\frac{6}{H}\right)^{5/2}\right] + 54(H-6)^{5/2} + 27H^{5/2}\left[1-\left(1-\frac{4}{H}\right)^{5/2}\right] + 8.1(H-4)$$

OUTFLOW RATING CURVE

TOP OF DAM EL 546

ELEVATION	STAGE	DISCHARGE [CFS]
546	0	-0-
547	1	198
548	2	666
549	3	1421
550	4	2490
551	5	3883
552	6	5578
553.2	7.2	8072

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-32

Project
Contract No. 316
File No.
Feature LAKE LAPAHNIEKA
Designed EMB
Date 7/27/81
Item
Checked
Date

ELEVATION	Q_1*	H_1	H_2 @ Q_1 **	Q/Q_1 (.9)	Q***
547	198	1	1	–	–
548	666	2	1.9	0.25	166.5
549	1421	3	2.8	0.30	426.3
550	2490	4	3.4	0.44	1095.6
551	3883	5	4.1	0.47	1825.0
553.2	8071	7.2	4.3	0.624	4992.0

* Q_1 - Discharge over dam at each elevation

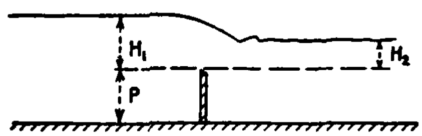
** H_2 - Stage Relative to Spillway Crest due to Backwater from Kiahas Brook Lane @ Q_1.

*** Q - Discharge at dam due to backwater effects from Kiahos Brook Lane.

BACKWATER CURVE @ KIAHAS BROOK LANE ROAD CULVERT.

BACKWATER FROM KIAHAS BROOK LANE WILL SUBMERGE THE SMALL DAM (CREST EL 546). THE FIGURE BELOW, OBTAINED FROM BRATER & KING'S "HANDBOOK OF HYDRAULICS" PG 5-18, WAS USED TO COMPUTE DISCHARGES OVER THE DAM GIVEN THE EFFECTS OF THE DOWNSTREAM CULVERT. NOTE: THE Q/Q, VALUES WERE REDUCED BY 20% SINCE THE COEFFICIENTS OF DISCHARGE USED IN DEVELOPING THE GUIDE CURVES ARE LARGER THAN THE COEFFICIENTS ALONG THE PROFILE AT THE DAM.

ASSUME: RECTANGULAR WIER CURVE #2.



Submerged Weir

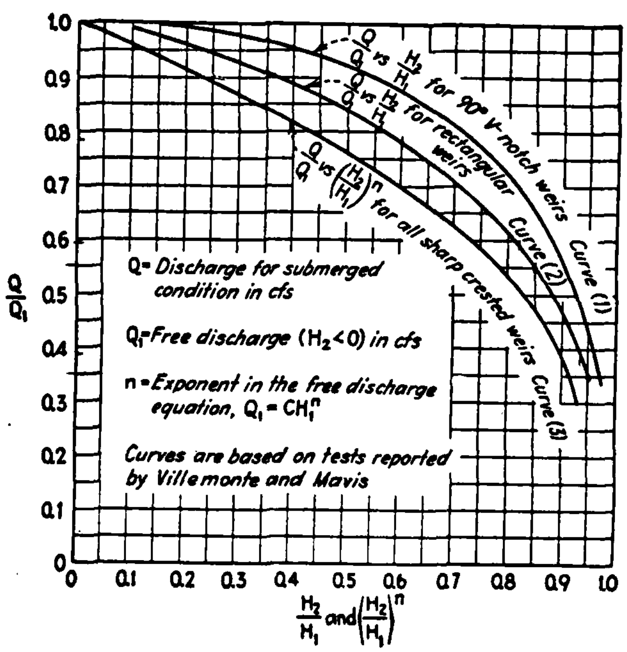
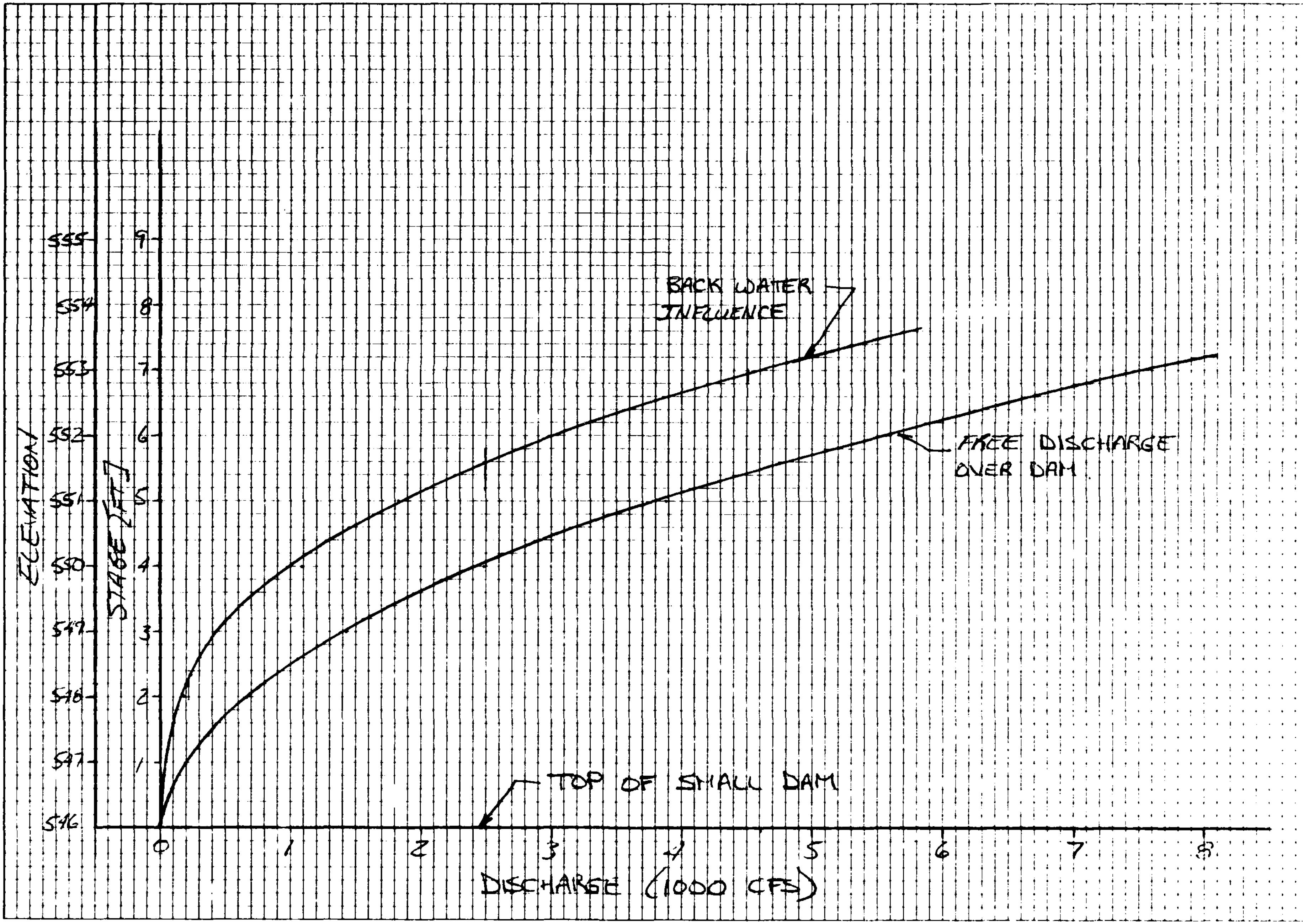


FIG. 5-5


ELEVATION
555
554
553
552
551
550
549
548
547
546
STAGE (FT)
1
2
3
4
5
6
7
8
9
BACK WATER
INFLUENCE
FREE DISCHARGE
OVER DAM
TOP OF SMALL DAM
0
1
2
3
4
5
6
7
8
DISCHARGE (1000 CFS)

INTERNATIONAL ENGINEERING COMPANY, INC.

Project ______ Contract No. 2616 Sheet D-35
Feature LAKE NARANEKA DAM Designed EHB File No. ______
Item ______ Checked [illegible] Date 7/22/81
Date ______

REACH C

STAGE - DISCHARGE CURVE

SECTIONS E to G

STAGE	A_E FT^2	A_G FT^2	A_{AVE} FT^2	R_E	R_G	R_{AVE}	$R^{2/3}_{AVE}$	$S^{1/2}$	V	Q	L [FT]	∀ AC-FT
5	1116	1124	1120	3.49	3.02	3.26	2.21	.114	10.72	12006	400	10.28
10	3162	3185	3174	6.92	7.13	7.03	3.69	.114	17.9	56814	400	29.15
15	5898	5603	5751	10.33	10.40	10.37	4.79	.114	23.2		400	52.8
1	134	67	101	.99	.79	.89	.92	.114	4.46	450	400	0.93
2	238	165	202	1.0	1.0	1.0	1	.114	4.85	980	400	1.85
3	550	442	496	1.96	1.9	1.93	1.55	.114	7.52	3730	400	4.55

$S = .013$

MANNING EQ $V = \frac{1.49}{.055} R^{2/3} (.013)^{1/2} = 4.85 R^{2/3}$

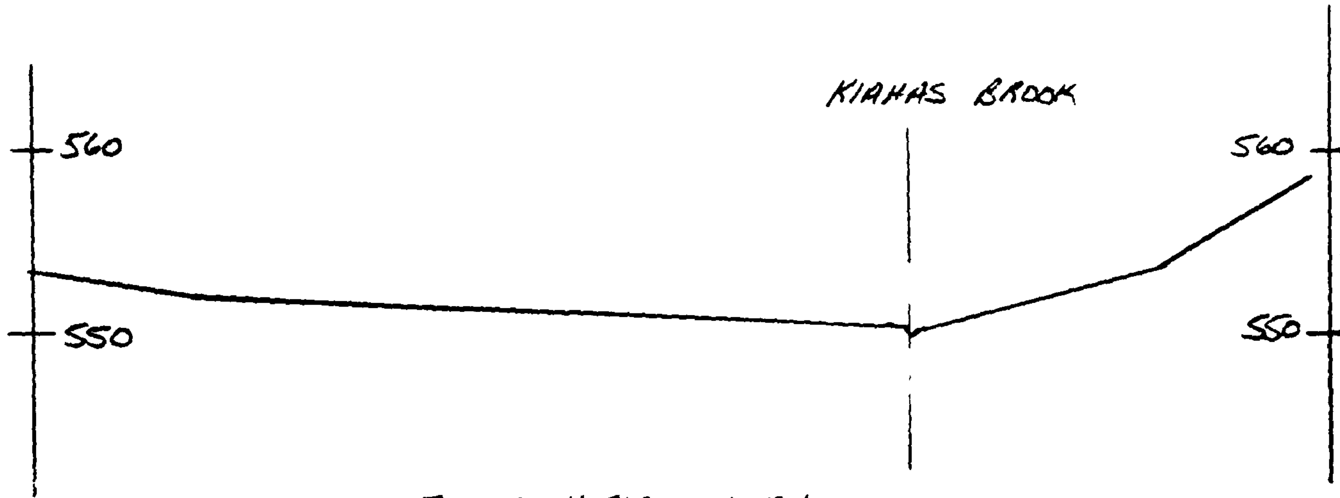
INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-36

Project ______ Contract No. 2616 File No. ______

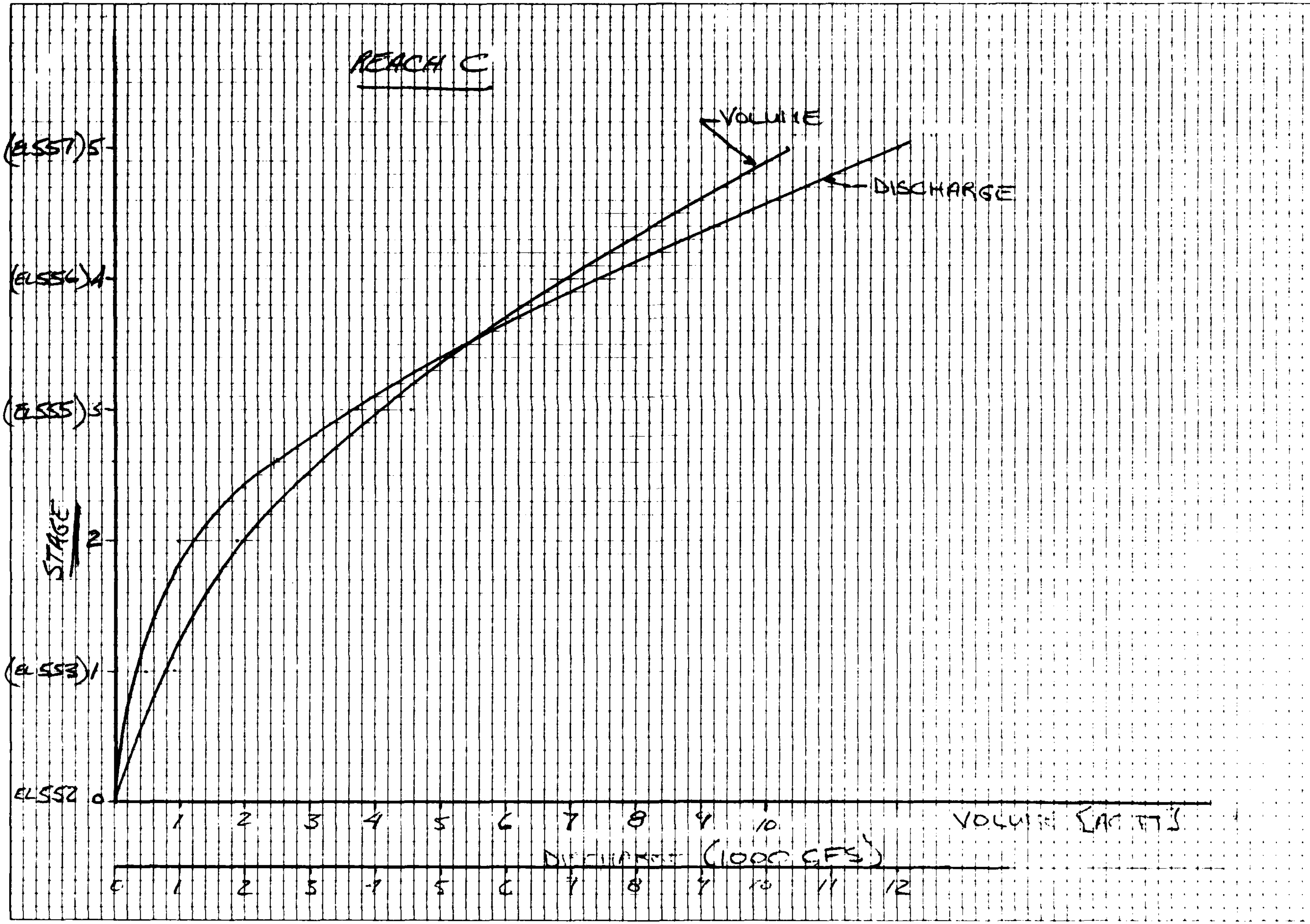
Feature LAKE NARANEKA DAM Designed EHB Date 7/27/81

Item ______ Checked ______ Date ______



SCALE HORIZ. 1"=50'
SECTION E-E

SCALE HORIZ. 1"=50'
SECTION G-G


REACH C
VOLUME
DISCHARGE
STAGE
(EL557) 5
(EL556) 4
(EL555) 3
2
(EL553) 1
EL552 0
1 2 3 4 5 6 7 8 9 10
VOLUME [AC FT]
DISCHARGE (1000 CFS)
0 1 2 3 4 5 6 7 8 9 10 11 12

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-[illegible]8

Project		Contract No. [illegible]	File No.
Feature	LAKE [illegible] DAM	Designed [illegible]	Date [illegible] 81
Item		Checked [illegible]	Date

REACH C

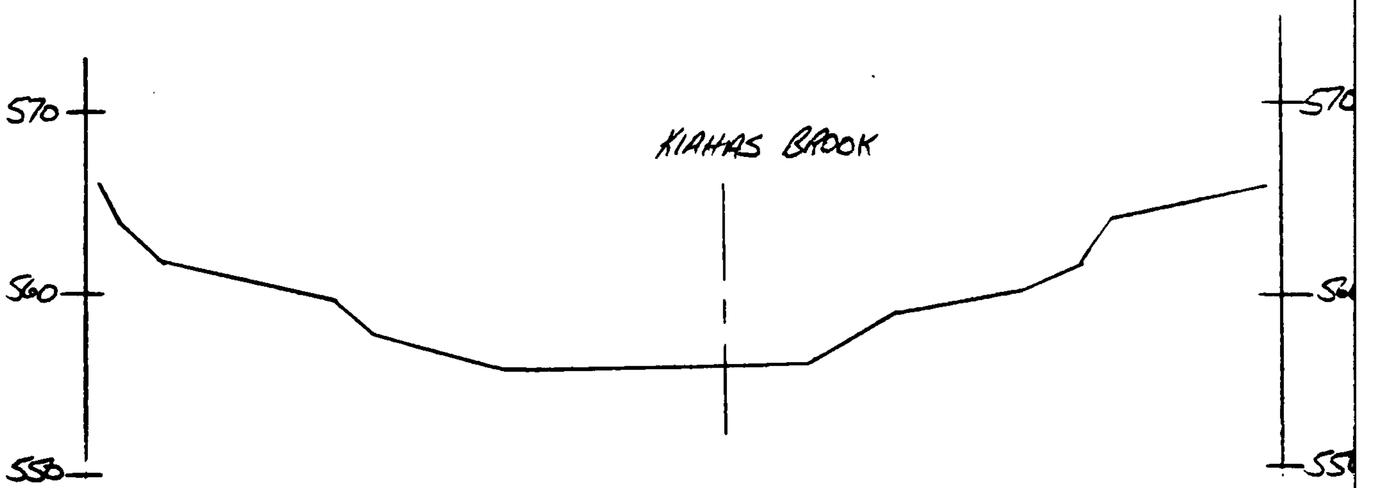
STAGE DISCHARGE CURVE

SECTIONS C to E

STAGE	A_C	A_E	A_{AVE}	R_C	R_E	R_{AVE}	$R^{2/3}_{AVE}$	$S^{1/2}$	V	Q	L	∀
1	119	134	127	1.03	.98	1.01	1.01	.111	4.78	607	700	2.04
3	413	550	482	2.66	1.96	2.31	1.75	.111	8.28	3990	700	7.75
5	744	1116	930	3.17	3.49	3.33	2.24	.111	10.60	11830	700	14.9[illegible]
10	2087	3162	2625	6.34	6.92	6.63	3.55	.111	16.80		700	42.18
2	246	238	242	1.76	1.00	1.38	1.24	.111	5.87	1421	700	3.89

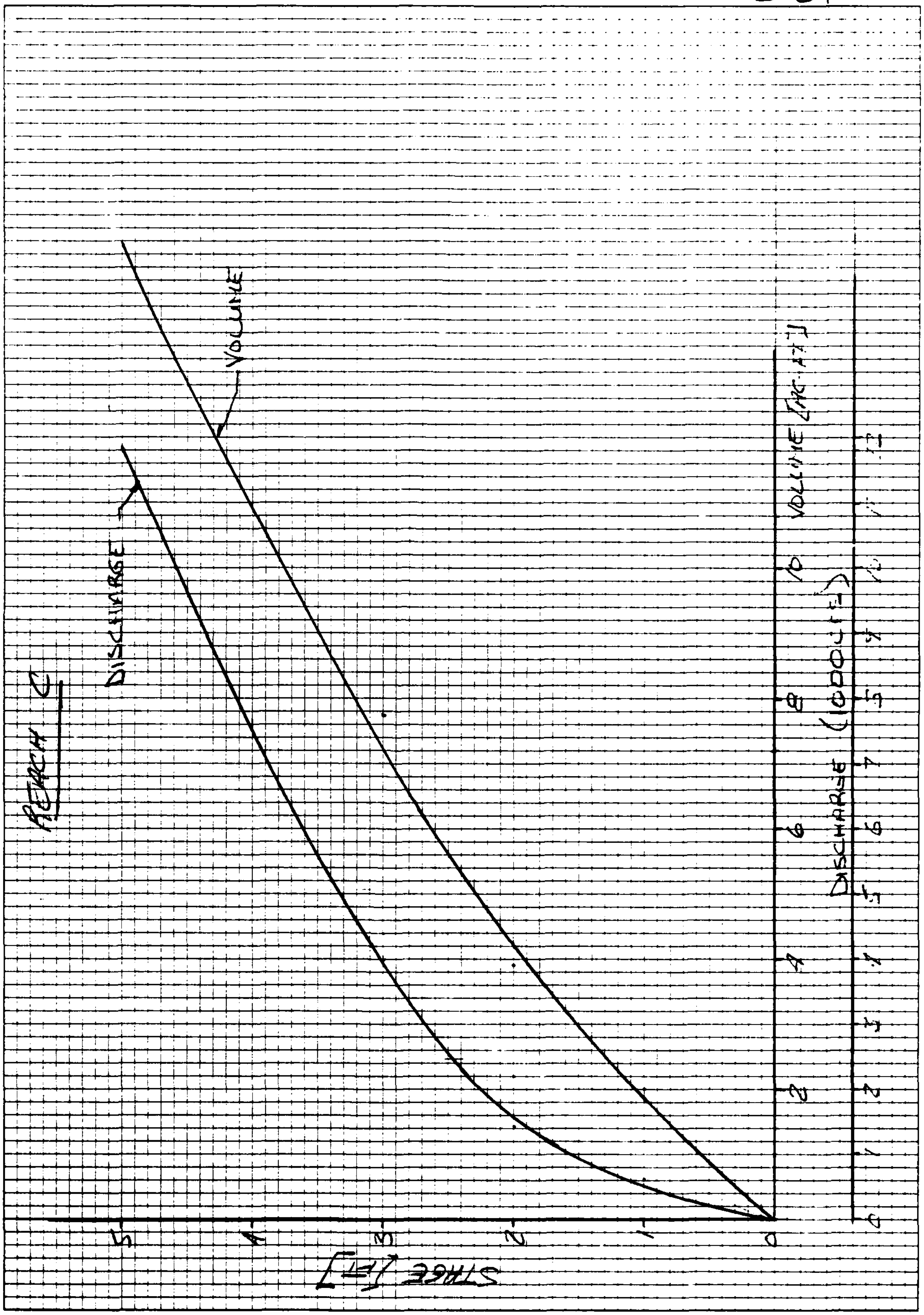
$S = .0125$

$$V = \frac{1.49}{.035} R^{2/3} S^{1/2} = 4.73 R^{2/3}$$



SECTION C-C

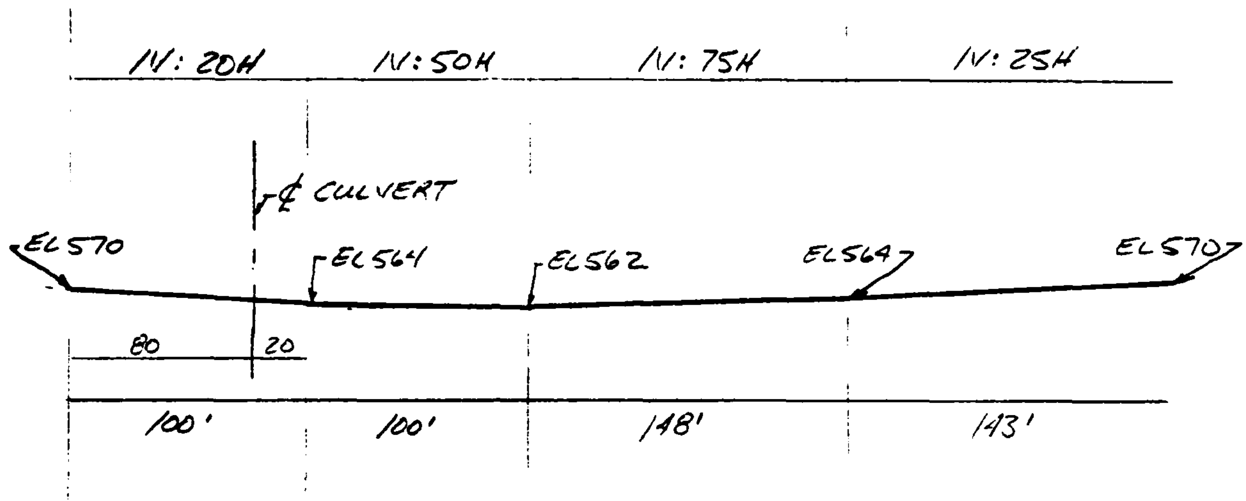
SCALE HORIZ 1"=50'


REACH C
DISCHARGE
VOLUME
STAGE [FT]
VOLUME [AC-FT]
DISCHARGE (1000 CFS)

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-40
Project
Contract No. 2616
File No.
Feature LAKE NAHANEKA DAM
Designed EHR
Date 7/22/81
Item
Checked
Date

DISCHARGE RATING CURVE @ BARLOW MOUNTAIN ROAD CULVERT



PROFILE ALONG BARLOW MOUNTAIN ROAD

i. ROAD CULVERT DISCHARGE
INVERT EL 560
WIDTH ⊥ TO FLOW ≈ 3'
HEIGHT ≈ 1.7'
AREA ⊥ TO FLOW = 5.1 FT²

$$Q_c = .6A\sqrt{2gh} = .6(5.1)\sqrt{2(32.2)h} \;;$$

WHERE h IS THE HEAD MEASURED TO THE ℄ OF THE CULVERT

ii. FLOW OVER ROAD
ASSUME C = 2.7 ; DATUM 562

SLOPE 1V:75H $\quad L_g = \frac{2}{5}(75)(H)$

$$Q_1 = 2.7\left(\tfrac{2}{5}(75)(H)\right)H^{3/2} = 81H^{5/2} \qquad H \le 2$$

$$Q_1 = 81H^{5/2}\left[1-\left(1-\frac{2}{H}\right)^{5/2}\right] \;; \qquad H > 2$$

SLOPE 1V: 50H $L_{eq} = \frac{2}{5}(50)(H)$

$$Q_2 = 2.7\left(\tfrac{2}{5}(50)(H)\right)H^{3/2} = \underline{\underline{54H^{5/2}}} \quad ; \quad H \le 2$$

$$Q_2 = 54H^{5/2}\left[1-\left(1-\frac{2}{H}\right)^{5/2}\right] \quad ; \quad H > 2$$

SLOPE 1V: 20H $L_{eq} = \frac{2}{5}(20)(H)$

$$Q_3 = 2.7\left(\tfrac{2}{5}(20)(H-2)\right)(H-2)^{3/2} = \underline{21.6(H-2)^{5/2}}$$

SLOPE 1V: 25H $L_{eq} = \frac{2}{5}(25)(H)$

$$Q_4 = 2.7\left(\tfrac{2}{5}(25)(H-2)\right)(H-2)^{3/2} = \underline{27(H-2)^{5/2}}$$

TOTAL DISCHARGE: $Q_T = Q_C + Q_1 + Q_2 + Q_3 + Q_4$

$$Q_T = 3.1\sqrt{64.4h} + 81H^{5/2} + 54H^{5/2} + 21.6(H-2)^{5/2} + 27(H-2)^{5/2}$$

$$① \quad \underline{Q_T = 3.1\sqrt{64.4h} + 135H^{5/2} + 48.6(H-2)^{5/2} \quad ; \quad H \le 2}$$

$$Q_T = 3.1\sqrt{64.4h} + 81H^{5/2}\left[1-\left(1-\frac{2}{H}\right)^{5/2}\right] + 54H^{5/2}\left[1-\left(1-\frac{2}{H}\right)^{5/2}\right]$$

$$+ 21.6(H-2)^{5/2} + 27(H-2)^{5/2}$$

$$② \quad \underline{Q_T = 3.1\sqrt{64.4h} + 135H^{5/2}\left[1-\left(1-\frac{2}{H}\right)^{5/2}\right] + 48.6(H-2)^{5/2} \quad ; \quad H > 2}$$

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-42

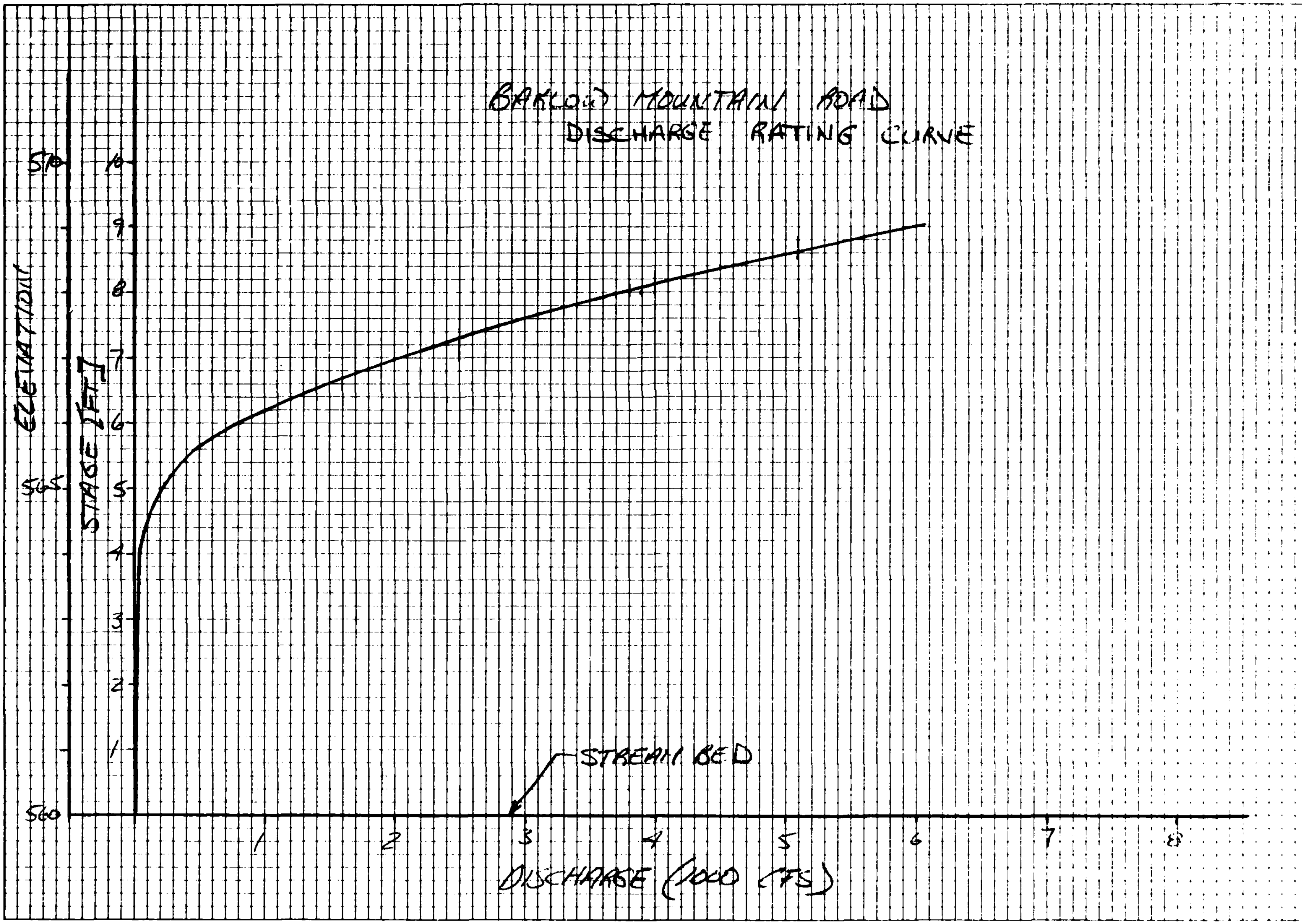
Project ___ Contract No. 2616 File No. ___

Feature LAKE NARANEKA DAM Designed EHB Date 7/22/81

Item ___ Checked ___ Date ___

OUTFLOW RATING CURVE

ELEVATION	h [FT]	H [FT]	DISCHAR[GE] CFS
560	0	0	0
562	1	0	25
564	3	0	43
565	4	1	135
566	5	2	819
568	7	4	3897
570	9	6	9214


BAKLOID MOUNTAIN ROAD
DISCHARGE RATING CURVE
ELEVATION
STAGE [FT]
570
565
560
10
9
8
7
6
5
4
3
2
1
STREAM BED
1
2
3
4
5
6
7
8
DISCHARGE (1000 CFS)

INTERNATIONAL ENGINEERING COMPANY, INC.

Sheet D-44

Project ______ Contract No. ______ File No. ______

Feature LAKE NARANEKH DAM Designed ______ Date 7/22/91

Item ______ Checked ______ Date ______

DISCHARGE RATING CURVE:

SECTIONS A - A1

SECTION	AREA [FT²]					
	2	4	6	8	10	14
A-A	17.8	62	303	612	1589	3684
A1	44	107	176	302	403	739

SECTION	PERIMETER [FT]					
	2	4	6	8	10	14
A-A	18	26	144	185	335	578
A-1	27	45	54	65	75	100

SECTION AVERAGE SLOPE $\frac{7}{200} = .035$

INTERNATIONAL ENGINEERING COMPANY, INC.

Project ____ Contract No. 2616 Sheet D-45
Feature LAKE NARANESA DAM File No. ____
Item ____ Designed EJK Date 7/27/81
Checked ____ Date ____

CHANNEL ROUTING SECTIONS A1 THROUGH A

STAGE	A_A	A_1	A_{AVE}	R_A	R_1	R_{AVE}	$R_{AVE}^{2/3}$	$S^{1/2}$	V	Q	L	V
2	17.8	44	31	.99	1.63	1.31	1.20	.187	9.56	296	200	.14
4	62	109	86	2.38	2.42	2.4	1.80	.187	14.34	1233	200	.39
6	308	176	242	2.14	3.26	2.7	1.95	.187	15.53	3758	200	1.11
10	1589	403	996	4.13	5.37	4.75	2.84	.187	22.62	22530	200	4.57
14	3684	739	2212	6.37	7.39	6.88	3.64	.187	29.99		200	10.16
8	612	302	457	3.31	4.65	3.98	2.52	.187	20.07	9171	200	2.1

MANNING EQ:

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

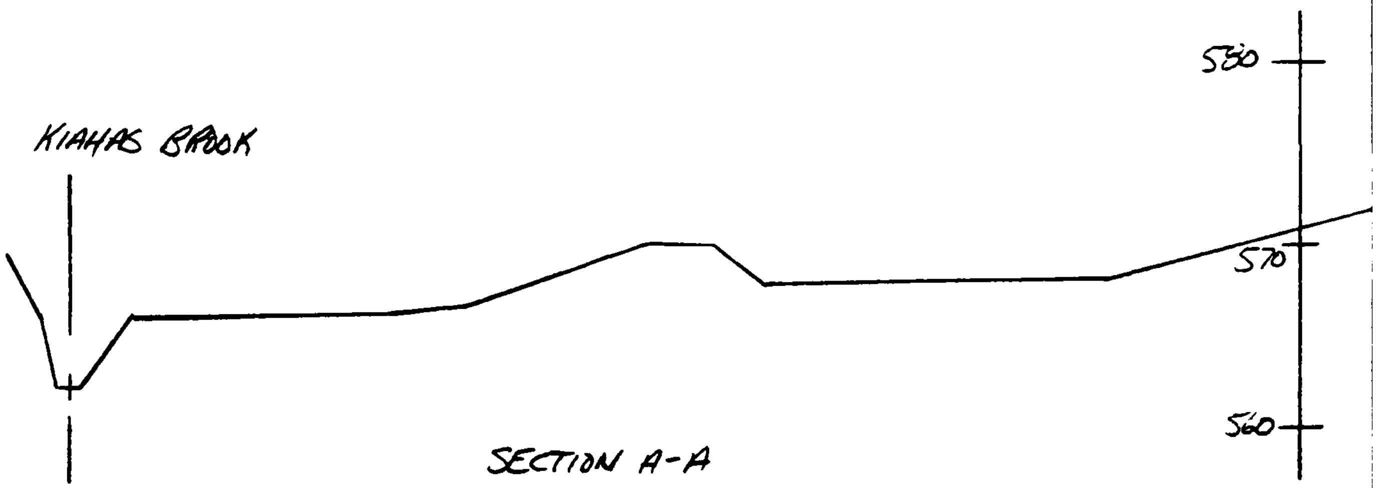
$n = 0.035$

$S_{AVE} = .035$

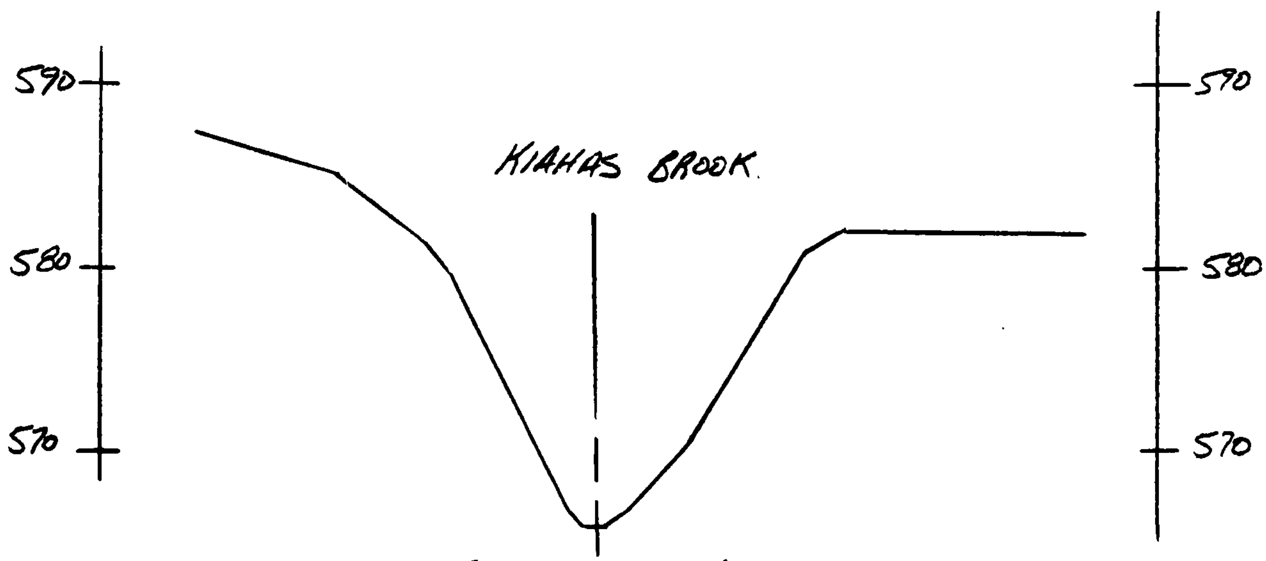
$$V = 7.964 R^{2/3}$$

INTERNATIONAL ENGINEERING COMPANY, INC.

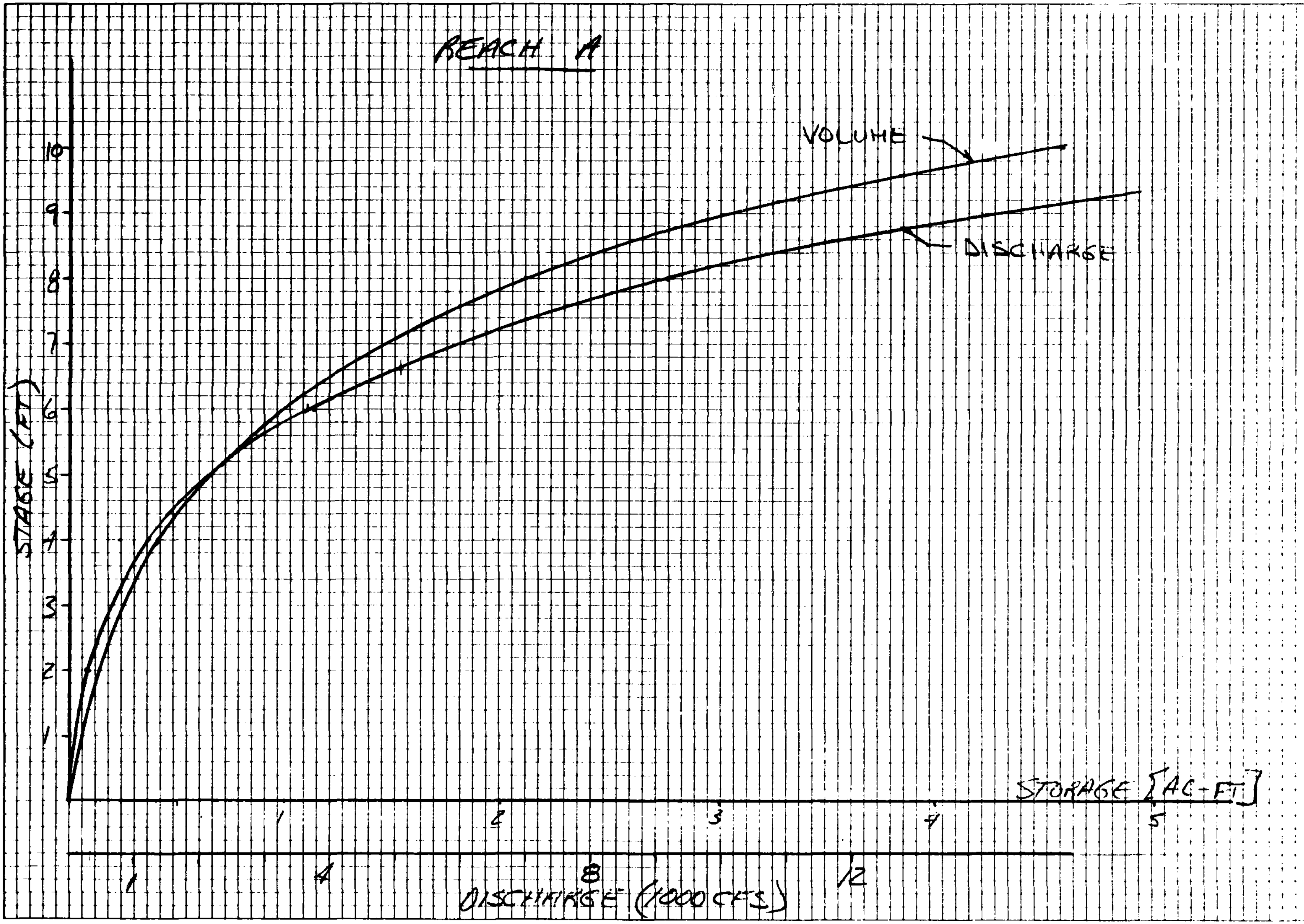
Project	Contract No. 2616	Sheet D-46
Feature LAKE NARANEKA DAM	Designed EHB	File No.
Item	Checked	Date 7/23/81
		Date



SECTION A-A
SCALE HORIZ 1"= 50'

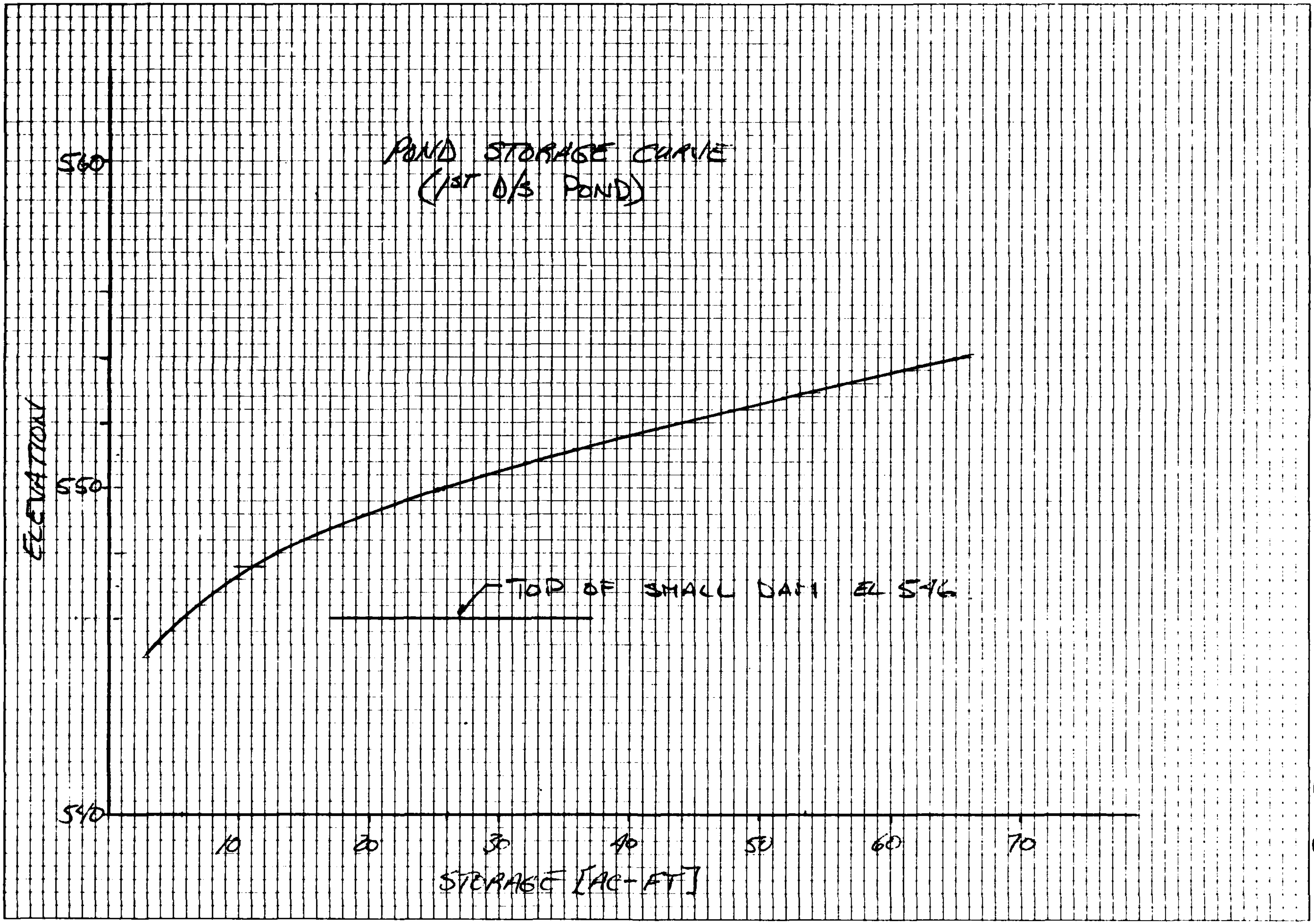


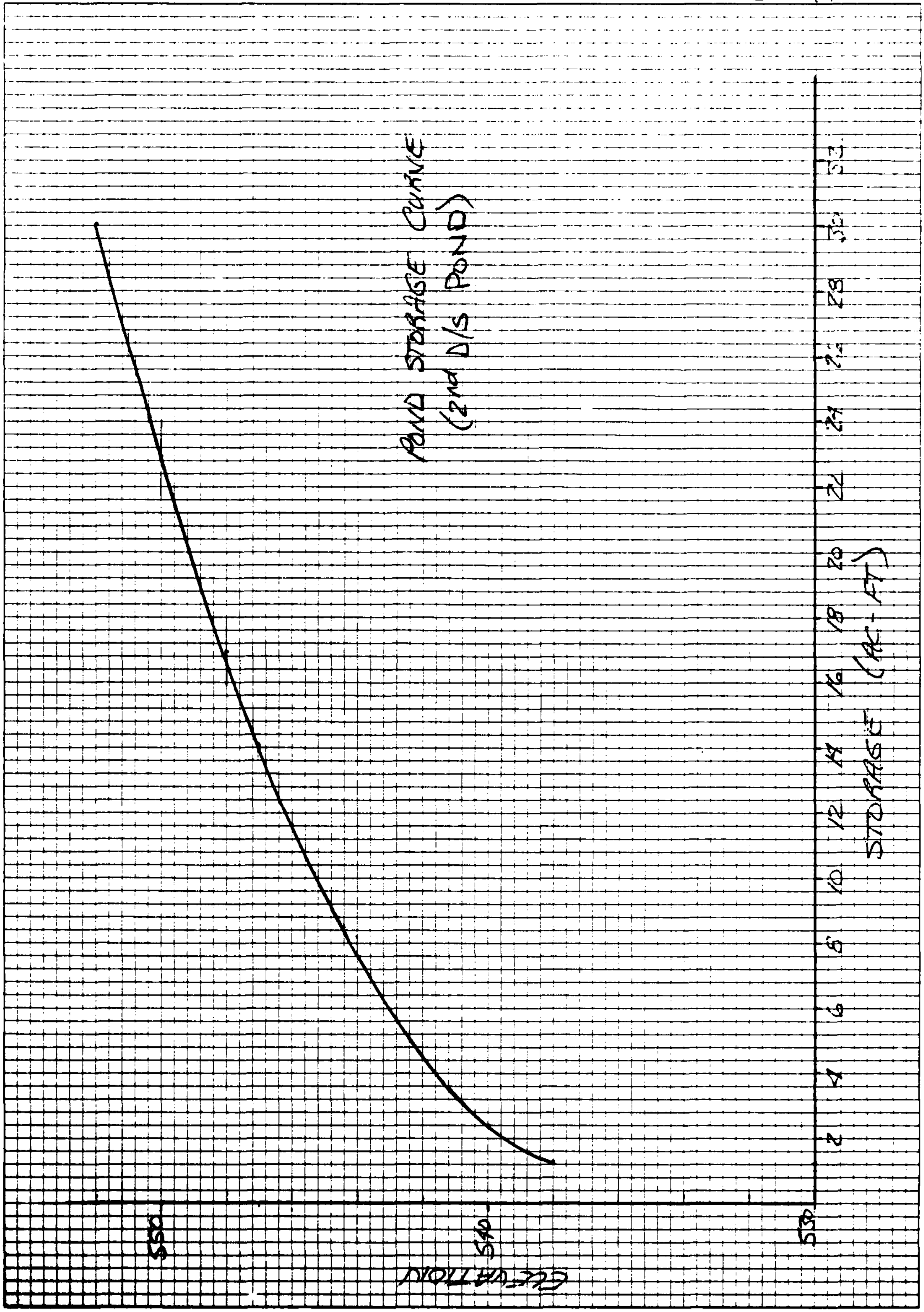
SECTION A1 - A1
SCALE HORIZ 1"= 50'


REACH A
VOLUME
DISCHARGE
STAGE (FT)
1
2
3
4
5
6
7
8
9
10
STORAGE [AC-FT]
1
2
3
4
5
DISCHARGE (1000 CFS)
4
8
12

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO MADE IN U.S.A.

46 0660




POND STORAGE CURVE
(2nd D/S POND)
STORAGE (AC-FT)
ELEVATION
530
540
550
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32

APPENDIX E

INFORMATION AS CONTAINED IN THE

NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME